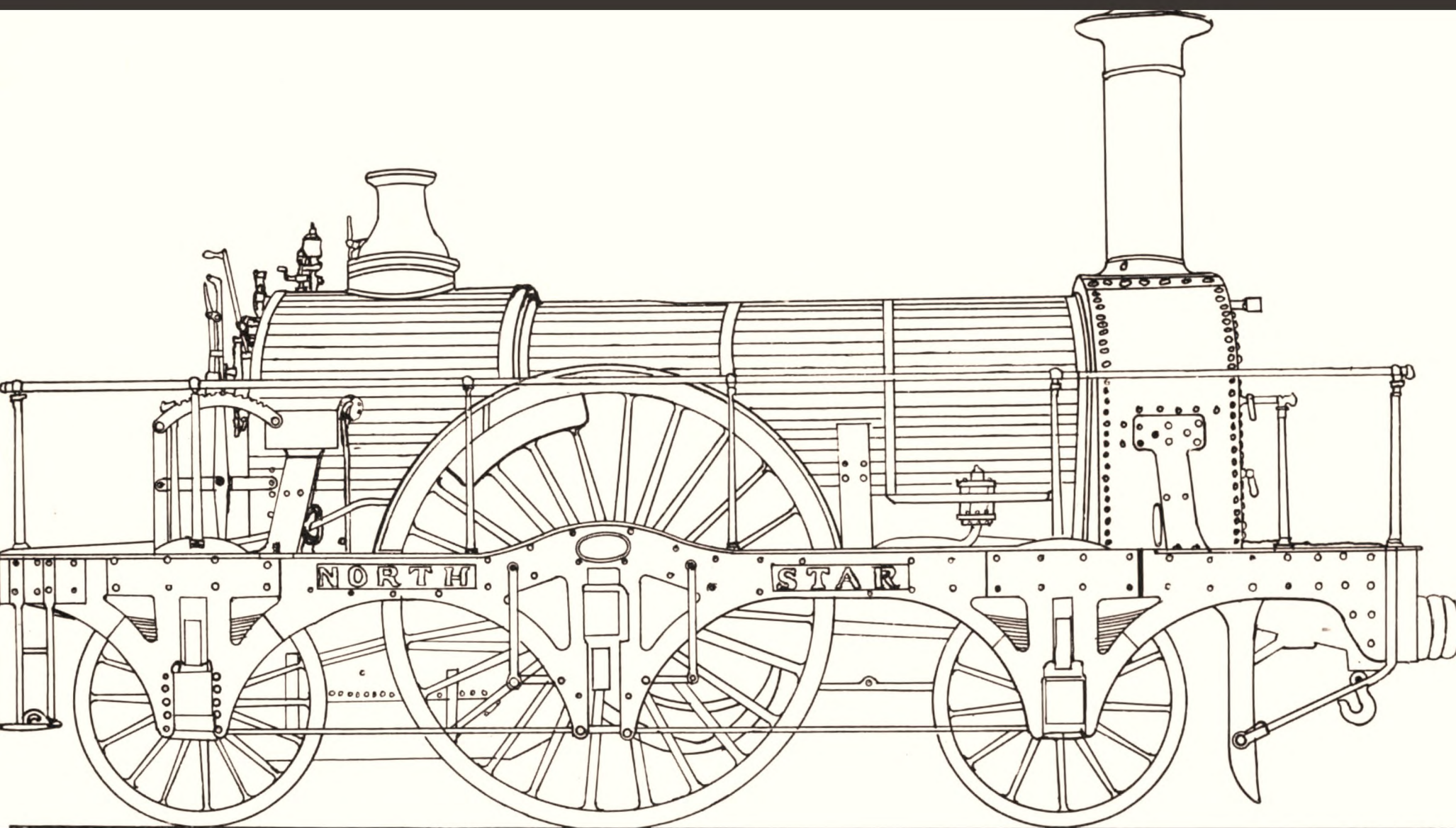


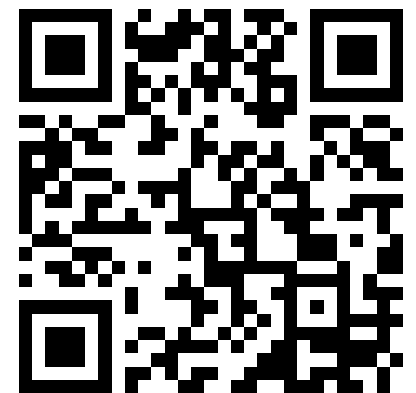


Pictorial history of the locomotive

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PICTORIAL HISTORY
OF THE
LOCOMOTIVE

COMPILED BY :::: WILLIAM WRIGHT



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PICTORIAL HISTORY OF THE LOCOMOTIVE

INTRODUCTORY



THE INFLUENCE which the locomotive has had upon the affairs of the present, as well as the last generation, gives an interest and importance to its history which is almost coextensive with that of the steam engine itself, as from the time when it was first proposed to apply steam to any purpose, its application to road carriages appears to have been also contemplated.

After such an idea presented itself it could, too, be readily brought into practicable form, for there existed in the last and preceding centuries a much better knowledge of mechanism than is now generally supposed, as most of the elements of the modern steam engine were known before the Christian era.

Hero, of Alexandria, whose book "*Spiritualia seu Pneumatica*," was written nearly or quite two hundred years before Christ, treated of the expansive force of steam and described the side valve, the spindle valve and common check, and illustrated the application of a metallic piston to a metallic cylinder.

When the attempts to apply the power of steam took a useful direction about two hundred years ago, locomotives were not overlooked. Solomon de Caus, while confined as a

madman in the Bicêtre at Paris, did not forget to include land transport among the many possible applications of steam power, and although in his work written in 1615, no evidence is given of his suggestion of and confidence in steam locomotion, the Marquis of Worcester, who visited de Caus in 1641, was apprised of his schemes under this head and is known to have adopted the proposition of carriages by steam, although no mention of this is made in his book "*Century of Inventions*." Savery, too, at the end of the seventeenth century, had given some attention to the subject. Neither de Caus, the Marquis of Worcester, nor Savery, however, did anything in the way of reducing their ideas of locomotive engines to a practical form. In 1759, too, a suggestion was made to James Watt to the effect that the power of steam could be utilized to drive land carriages.

The first locomotive was made, however, by a Frenchman Nicholas Joseph Cugnot, in 1769, and he was the first to apply the high pressure engine with cylinders and pistons to the production of rotary motion, and was also the first to apply the energy of steam to what is still the principal sphere of animal power.

A larger locomotive made upon his plans in 1771 is still preserved in the Conservatory of Arts and Sciences at Paris.

Then followed the efforts of James Watt, William Murdoch, William Symington, Oliver Evans, Richard Trevethick,

Matthew Murray, William Hedley, George Stephenson and Timothy Hackworth. Watt took out a patent on a locomotive engine in 1784, but no engine was ever constructed or attempted.

William Murdock made a toy locomotive in 1784, with a single vertical cylinder three-quarters of an inch in diameter, the piston rod with a 2-inch stroke being connected to one end vibrating upon a joint at the other, as in the class of engines known as "grasshoppers." This engine is still carefully preserved at Soho, England. William Symington also made a working model of a steam carriage in 1786.

Oliver Evans carried on a millwright's business in Philadelphia and applied wheels to a steam dredging machine by which it was propelled by its own engine from the factory to the river about one and one-half miles distant, which was in the year 1804.

Richard Trevethick made the first tramway locomotive in 1803, and it was first worked in Cornwall and afterward brought to London and placed on exhibition.

Matthew Murray, of Leeds, made a locomotive in 1812 for Mr. John Blenkinsop, the proprietor of Middleton colliery, near Leeds, who had taken out a patent for increasing the adhesion of the locomotive by gearing it by means of a pinion into a rack rail along one side of a line of railroad.

William Hedley, colliery viewer for Mr. Blackett, of Wylam, constructed a locomotive in 1813, and before doing so experimented to ascertain whether the ordinary adhesion of the wheels of an engine on smooth rails would be sufficient to insure the useful application of the whole of the steam tractive force, and it has been claimed that he was the father of the present system of working locomotives by means of the friction between wheels and smooth rails.

George Stephenson constructed a locomotive, in the workshops of the Killingworth colliery, in 1814, for drawing coal from the pit, but after a year's trial was found to have no advantages over horse power, the radical defects being a single flue boiler and large stack. In his engine, built in 1815, he abandoned crank axles and the wheels were coupled by an endless chain and after some years, outside coupling rods superseded this method.

Timothy Hackworth was originally an employee of the Wylam Railway and was made locomotive engineer of the Stockton and Darlington Ry. This line was opened for passengers and freight traffic, September 27, 1825, and in addition to stationary engine and horse power had five locomotives, four from Stephenson's factory and one made by Wilson, of Newcastle. These engines gave such unsatisfactory results that the directors seriously considered their abandonment for horses, but Hackworth determined to alter and improve one of them and named it the "Royal George" which commenced working in October, 1827.

In the spring of 1829, the Liverpool and Manchester directors were upon the point of adopting fixed engines and ropes for working their line, but through the efforts of some of the members of the board it was decided to make a conclusive trial of locomotives at Rainhill, near Liverpool. On the first of October, 1829, the day fixed for the trial, four locomotives were nearly ready and the contest was postponed until the 6th. George Stephenson entered the "Rocket," Timothy Hackworth, the "Sanspareil," Messrs. Jno. Braithwaite and John Ericsson, the "Novelty," and Mr. Burstall, the "Perseverance," the last named, however, being withdrawn on account of being unfit for service.

After six days trial the "Rocket" being the only engine that covered the stipulated distance was awarded the prize amounting to £500 sterling, and the adoption of locomotives on passenger railways and the consequent great results to which railways have attained since that time are due to the success of this engine.

The application of locomotives to railroads in this country was contemporaneous with their practical use for that purpose in England, for at the same time the Stephensons were building their "Rocket," they were supplying two engines of the same pattern to the Delaware & Hudson Co. for the Carbondale Railroad.

The "Rocket" was put in operation in October, 1829, and the two locomotives just mentioned arrived in New York in the winter of 1828-1829, together with one built by Foster, Rastrick & Co. of Stourbridge, England, also for the same road.

This latter engine was called the "Stourbridge Lion," and was tried and run on the Carbondale Road, August 9, 1829, by Horatio Allen, who was the first person to run a locomotive on a railroad in America.

Locomotive building was begun in this country in 1830, and the first one completed was the "Best Friend" and was built at the West Point Foundry Association, of New York, for the South Carolina Railway and tried in August of that year.

In 1831 and 1832, the West Point Foundry Association and Mathias W. Baldwin, of Philadelphia, were filling orders for various railroads, and by 1835, Messrs. Rogers, Ketchum and Grosvenor, of Patterson, N. J., William Norris and Garrett and Eastwick, of Philadelphia, as well as others, were extensively engaged in locomotive building.

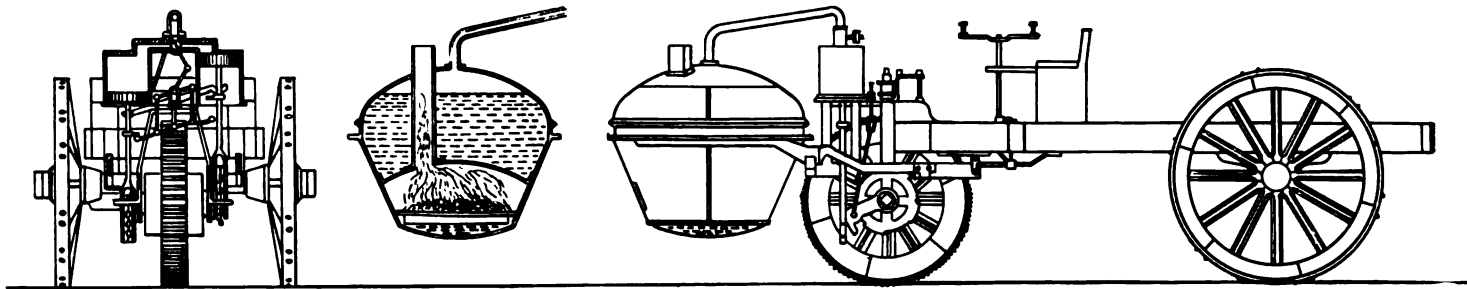
The first American locomotives were designed to a great

extent from designs furnished by English engines. It however soon became evident that the condition of railroads in this country made requirements different from those in England, and in view of this, it was desirable to have a locomotive which would be more flexible and the weight of which would be more equally distributed on the rails than was the case with the English engines, and hence a departure from this prototype became necessary and the so-called "American type" of locomotive was originated.

Between the era of the "Rocket" and the mammoth engines of to day, lie the classes of engines familiar to every one because examples are still to be found, and while there may be inventions that may be considered more marvelous than the modern high speed locomotive, yet none more displays in concrete result the power of man to imprison so mighty a force in so small a compass.



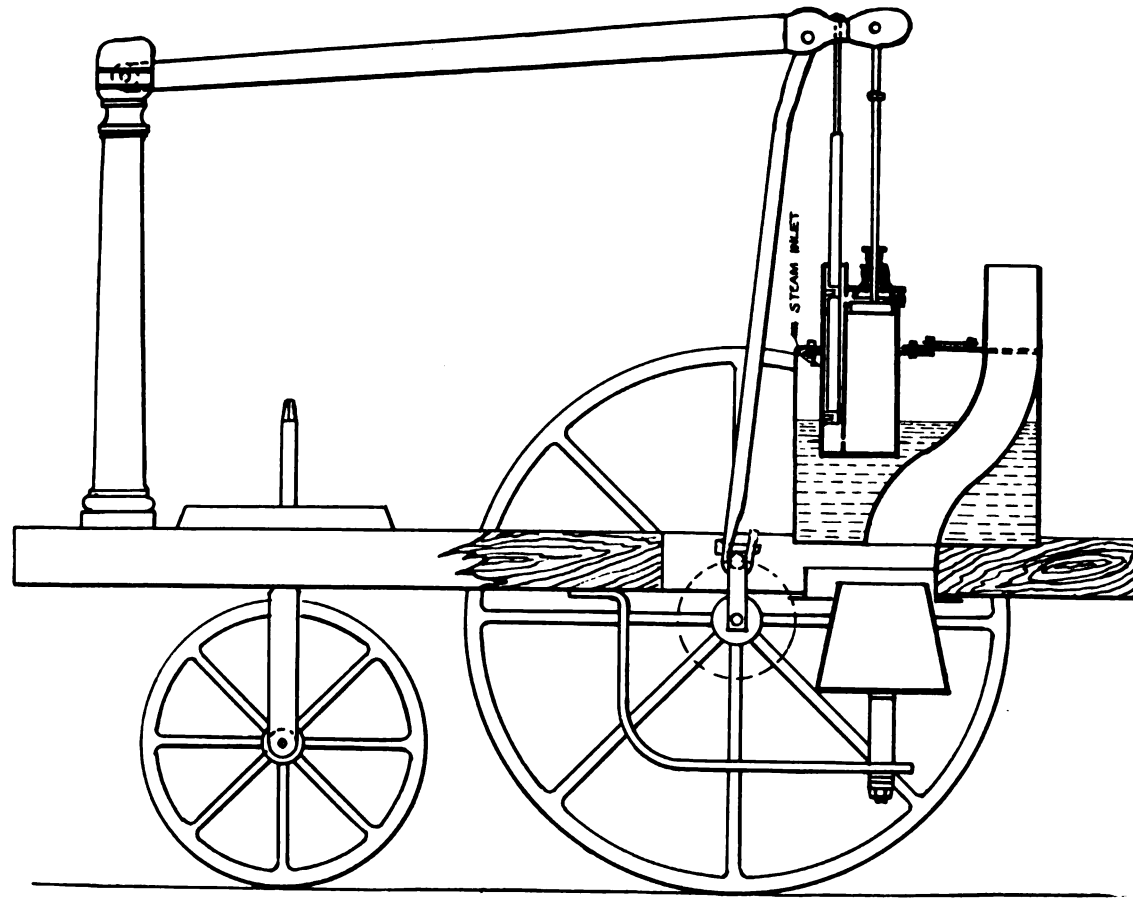
1 DRIVING WHEEL, 50" DIA., 7" WIDE AT TIRE.
 2- 13" SINGLE ACTING CYLINDERS.
 SPEED, 2 $\frac{1}{4}$ MILES PER HOUR, CARRYING 4 PERSONS.
 ACTUAL HORSE POWER, 5.
 WEIGHT IN WORKING ORDER, 12 TONS.



Cugnot's Locomotive, 1771.

One of the earliest attempts in the way of Steam Locomotion was the engine of Nicholas Joseph Cugnot of France; designed to run on common roads. His first carriage was put in motion by the impulsion of two single acting cylinders, the pistons of which acted alternately on the single front wheels. It traveled about 3 or 4 miles an hour and carried 4 persons; but, from the smallness of the boiler, it would not continue to work more than 12 or 15 minutes without stopping to get up steam. Cugnot's Loco. presented a simple and ingenious form of a high pressure engine, and, though of rude construction, was a creditable piece of work considering the time. He made a second engine, with which several successful trials were made in the streets of Paris, which excited much interest. An accident, however, put an end to the experiments. Turning the corner of the street, one day, near the Madeleine, when the machine was running about 3 miles an hour, it upset with a crash, and, being considered dangerous, was locked up in the Arsenal.

Cugnot's Loco. is still to be seen in the Museum of the Conservatoire des Arts et Metiers, at Paris.



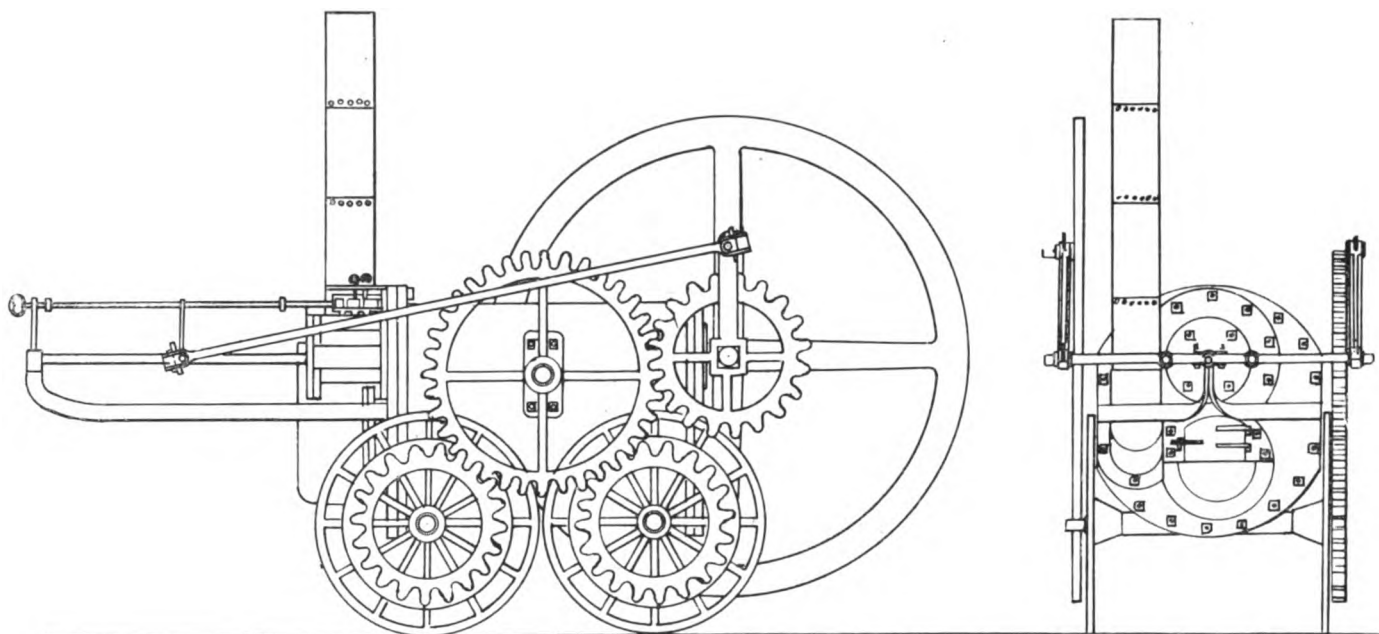
~~~~~ *William Clurdock's Locomotive, 1784.* ~~~~~

This cut shows a longitudinal section of a miniature locomotive, made by William Clurdock in 1784.

It had a single vertical cylinder  $\frac{3}{4}$ " dia. by 2" stroke, the slide valve was actuated by a tappet motion, the beam striking it up and down alternately at each end of the stroke, the piston rod was connected to one end of a beam vibrating upon a joint at the other, as in the class of engines now known as "grasshoppers". A connecting rod was joined to the beam, close to its working end, and turned a crank in the axle of a pair of driving wheels  $9\frac{1}{2}$ " dia. The cylinder was half immersed in a small copper boiler, through which a flue passed obliquely, the heat being supplied by a spirit lamp beneath.

This machine is still in existence, and is the property of Mr. Clurdock, manager of the Sun Foundry, Leeds, and grandson of William Clurdock.





*Trevithick's Locomotive, 1803.*

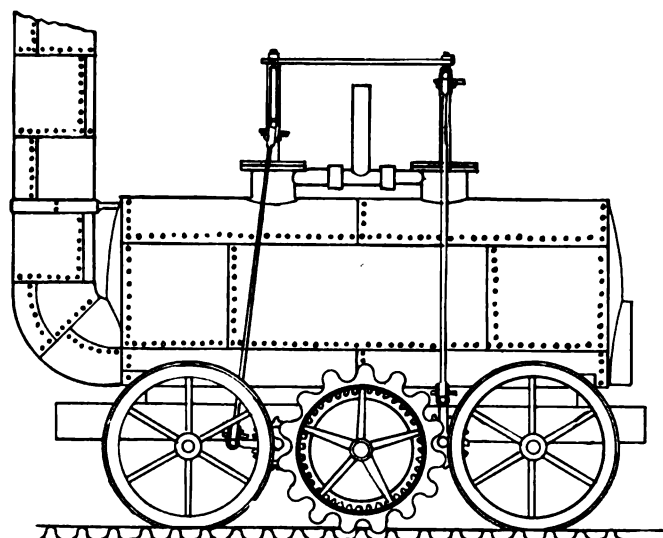
*~~~~ Trevithick's Locomotive, 1803 ~~~~*

*This Engine was built by Richard Trevithick, a Cornish miner, in consequence of a wager of 1000 guineas, that he would convey a load of iron a distance of 9 miles into Merthyr Tydfil, South Wales, upon a cast iron tramroad by the power of steam alone.*

*The engine was finished in 1804 and succeeded in accomplishing the feat of drawing after it several wagons containing 10 tons of bar iron at the rate of 5 miles an hour, but it was an ill constructed machine and having got out of order it was deserted by its builder.*

*The boiler was cylindrical in form, flat at the ends and made of cast iron; the furnace and flues were inside the boiler in which a single cylinder of 8 dia. and 54" stroke was immersed.*

*In this engine was first employed the "force draught" created by the steam, for working without a high stack, the exhaust steam being turned into the stack about a foot above its junction with the boiler.*



Murray's Locomotive upon Blenkinsop's Railway, 1812.

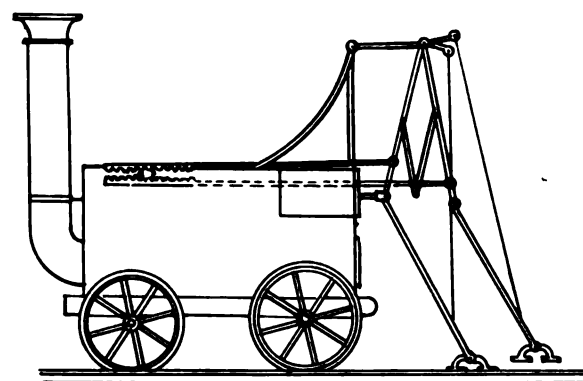
Murray's Locomotive upon Blenkinsop's Railway - 1812.

In 1811 a Mr. Blenkinsop of Leeds took out a patent for a machine and rail adapted to each other, a rack or toothed rail was to be laid down along one side of the track, into which a toothed wheel of his locomotive worked.

The boiler of his engine was supported by a carriage upon four wheels without teeth and resting immediately on the rails. These curved entirely independent of the working parts of the engine and merely supported its weight, the progress being effected by the motion of the cogged wheels working on the cogged rail.

This engine began running on the railroad from the Cliddleton collieries to the town of Leeds, about  $3\frac{1}{4}$  miles on the 12<sup>th</sup> August, 1812.

For a number of years it was a permanent object of curiosity and was visited by crowds of strangers from all parts. These engines (for several were afterward constructed) drew after them 30 coal cars, loaded, at a speed of  $3\frac{1}{4}$  miles per hour, and were in use for many years and may justly be considered as the first instance of the employment of locomotive power for commercial purposes.



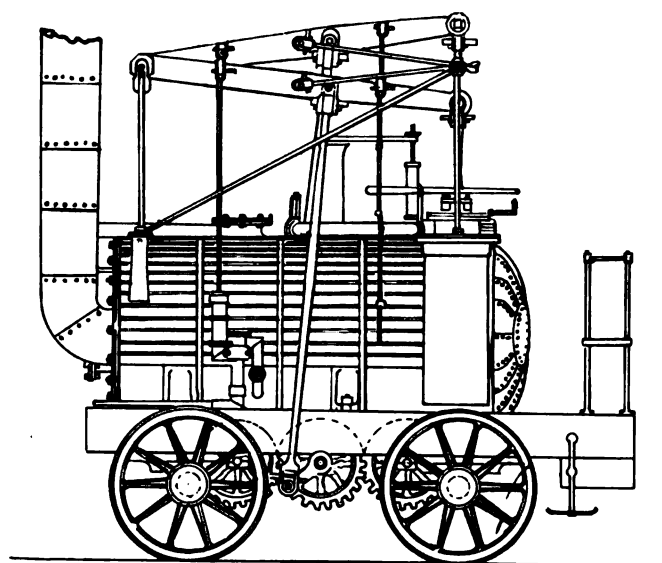
WILLIAM BRUNTON LOCOMOTIVE, 1813.

~ William Brunton's Locomotive, 1813. ~

This Locomotive or 'Mechanical Traveler' was built by Mr. Brunton of the Butterby Works, Derbyshire, in 1813.

This Engine had two legs attached to the back part, which, being alternately moved by the engine, pushed it before them. The legs, or propellers, imitated the legs of a man, or the forelegs of a horse, with joints, and when worked by the machine, alternately lifted and pressed against the ground or road, propelling the engine forward. This Engine moved on a railway at the rate of  $2\frac{1}{2}$  miles per hour with the tractive force of 4 horses.

The Engine never got beyond the experimental state for on one of its trials it unhappily blew up, killing and wounding several bystanders, was never repaired, and laid by as one of the failures of the times.



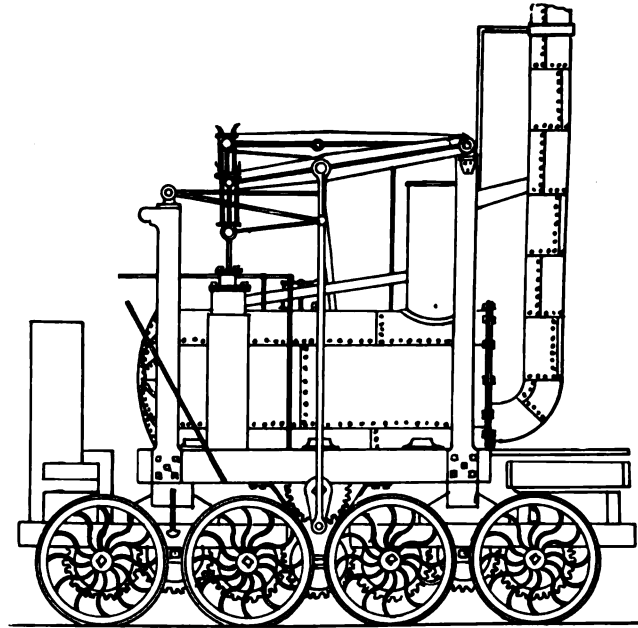
Hedley's Locomotive, "Puffing Billy" (now in the South Kensington Museum), 1813.

*~~~~ Hedley's Locomotive, "Puffing Billy", 1813. ~~~~*

*This Engine was constructed, at Wylam, by W<sup>m</sup> Hedley, Mechanical Engineer for Mr. Blackett, the proprietor of the Wylam Colliery near Newcastle on Tyne and was set to work in 1813.*

*This Engine had a wrought iron boiler with a return flue the chimney being placed at the same end as the fire door.*

*Two vertical cylinders were employed; the pistons and rods being connected to beams centred at each end, an arrangement known as the "grasshopper". There were four wheels of equal diameter to which the motion of the pistons was communicated by toothed gearing.*



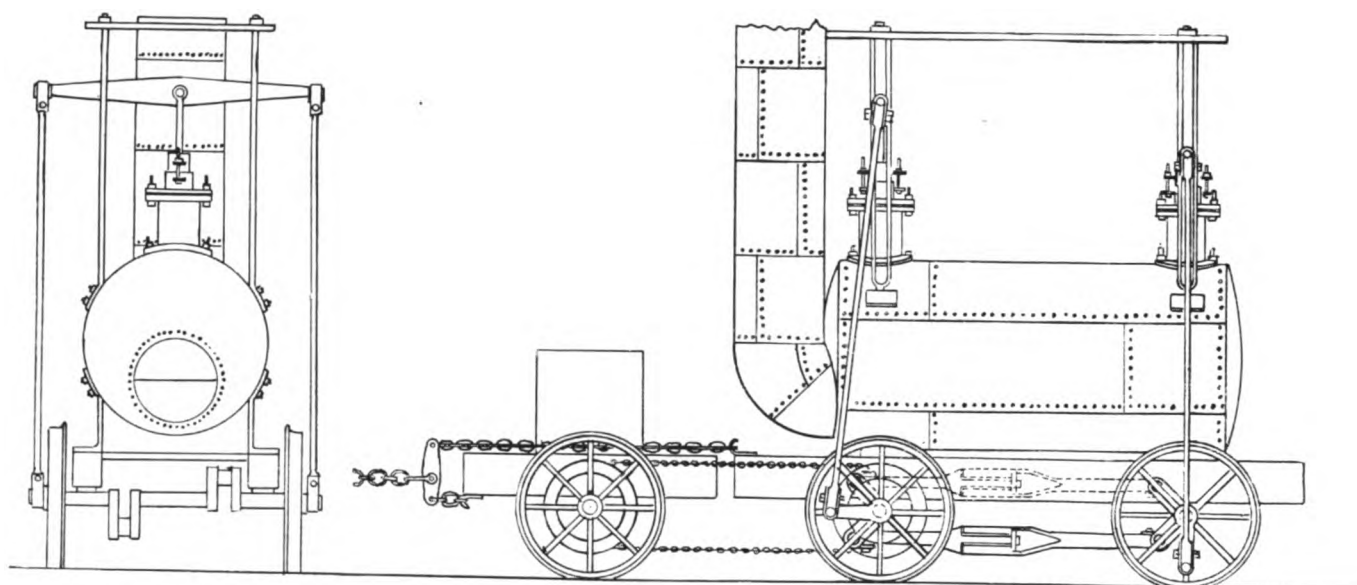
Hedley's Engine, Wylam Railway, 1815.

~~~~ Hedley's Engine, Wylam Railway, 1815 ~~~~

This Engine was practically the same as the "Puffing Billy", but was of greater power as the cast iron rails, then employed, were only able to support them when their weight was distributed upon eight wheels, also geared to work together so as obtain the adhesion of them all.

These Engines embodied two improvements of much importance, the first being the return flue boiler to give additional heating surface and to render the course of the flame more effective, the other of adopting a chimney of small diameter (12 inches) which materially increased the draft.

Trevethick was, perhaps, the author of both these improvements but Hedley was the first to bring both into practical use.



Stephenson's Engine, 1815.

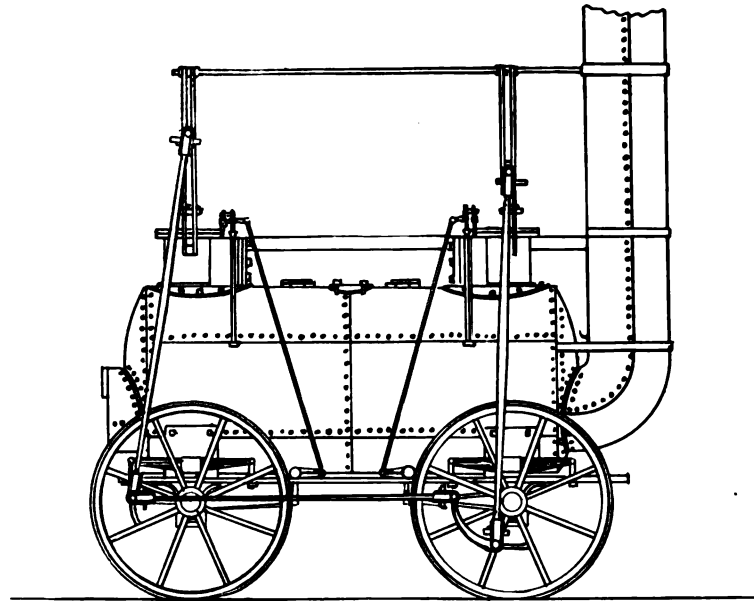
Stephenson's Engine, 1815.

This Engine had vertical cylinders immersed within the boiler, each piston rod being secured to a long crosshead spanning the whole width of the Engine and having a pair of connecting rods working downward and turning one pair of wheels by means of crank pins fixed in their arms.

It was proposed to couple the wheels together by a pair of coupling rods working on cranks forged in both axles and the adhesion of the wheels of the tender was to be also obtained by coupling them to one pair of the engine by means of an endless chain.

The attempt was abandoned and the engine wheels were coupled by an endless chain until, after some years, outside coupling rods were adopted.

This Engine was constructed under Geo. Stephenson's directions, in the workshops of the Killingworth Colliery in 1815.



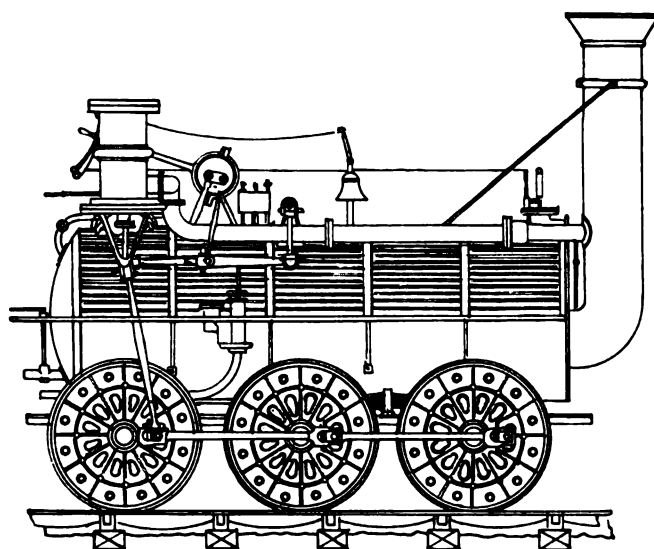
Stephenson's Engine 'Locomotion' or No. 1, 1825.

~ Stephenson's Engine 'Locomotion' or 'No. 1', 1825 ~

This Engine was the first or 'No 1' built by George Stephenson in his own establishment at Newcastle-on-Tyne, which began business in 1824, and was delivered in time for the opening of the Stockton and Darlington Railway on Sept. 27th 1825.

The general dimensions of the engine are as follows: - diameter of cylinder 9"; stroke of piston 24"; diameter of wheels 48"; total heating surface, 60 square feet; weight of engine 6 tons, 10 cwt., capacity of tank, 240 gallons.

This engine, on the opening day, drew thirty eight vehicles upon which were four hundred and fifty passengers and about ninety tons of merchandise, the highest speed obtained being twelve miles an hour, the average four to six.



Hackworth's "Royal George," 1827.

~ Hackworth's "Royal George" - 1827. ~

This Engine was altered from a Locomotive of the "Puffing Billy" type by Timothy Hackworth and commenced working in October 1827.

The boiler was a plain cylinder 13 ft. long and 4 ft. 4 in. in diameter.

The return flue of the Mylam Engines was adopted and a liberal amount of heating surface thus obtained. There were six coupled wheels 4 feet in diameter, and the cylinders, which were placed vertically at the end opposite to the fire place, were 11" diameter the stroke of the piston being 20 inches. The piston rods worked downward and were connected to the first pair of wheels. These were without springs, so that the pistons should not jump the wheels up and down but the middle and back pairs of wheels carried their load through stout springs.

The Rainhill Trials on the Liverpool and Manchester Ry.

In the Spring of 1829, the Directors of the Liverpool and Manchester Ry. decided to make a trial of locomotives before adopting fixed engines and ropes for working their line and a prize of £.500. "open to all comers" was determined upon on the 20th April 1829 and publicly offered on the 25th of the same month.

On the 1st of October - the day fixed for the competitive trials - four locomotive steam engines were nearly ready and to give additional time to the various makers, the contest was postponed until the 6th of the same month.

M^r.^{rs} Stephenson entered the "Rocket" in the name of his son, the late Robert Stephenson; Timothy Hackworth entered the

"Sanspareil", Messrs John Braithwaite and John Ericsson brought forward the "Novelty" and M^r. Burtall sent the "Perseverance". The last named engine was found unfit to take part in the contest and was withdrawn.

The trials did not finally commence until the 8th of October. The length of run adopted was $1\frac{1}{2}$ miles only on a level part of the line at Rainhill near Liverpool.

The "Rocket" was tried first on the 8th, the "Novelty" on the 10th and the "Sanspareil" on the 13th.

The whole of the experiments with the "Rocket" were performed without accident of any kind and with no delay inseparable from the circumstances under which the trials were conducted.

The engine made a speed of 28 miles per hour.

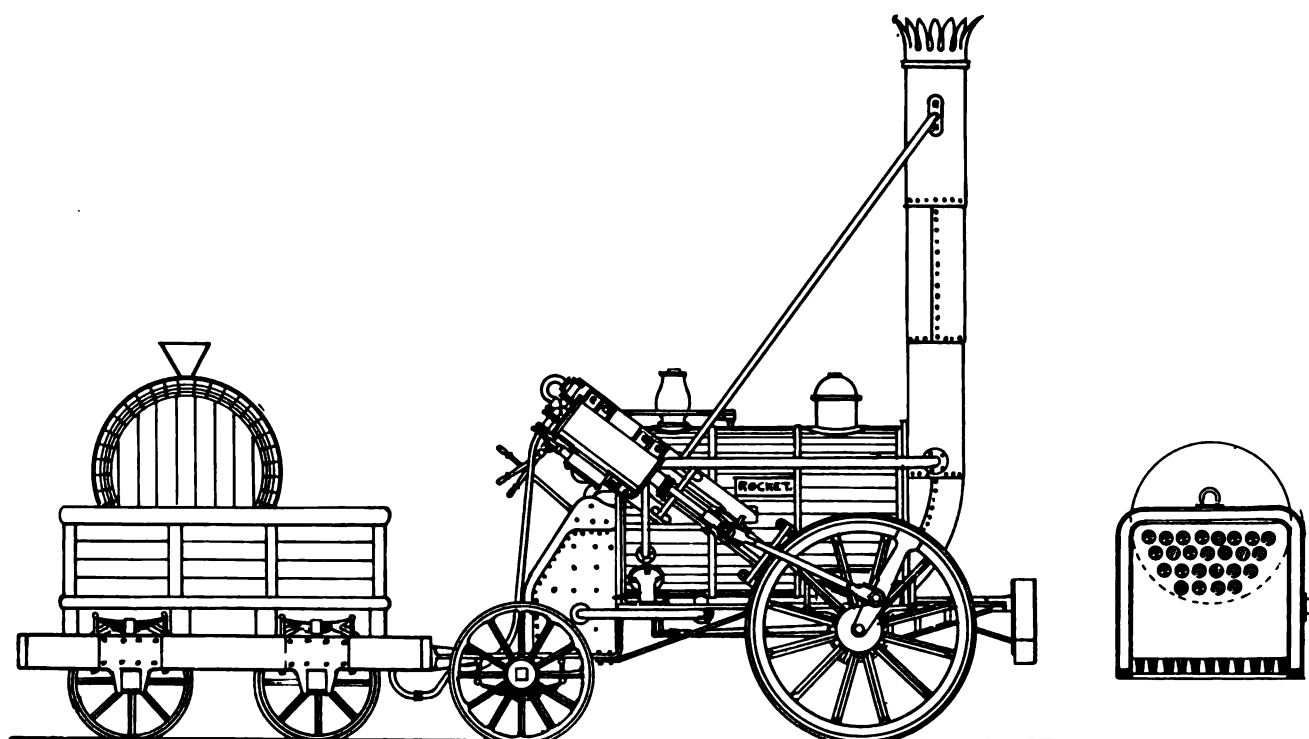
The experiments with the "Novelty" were put a stop to after only two runs of $1\frac{1}{2}$ miles were made, owing to some part of the machinery giving way. Subsequently, on the same day, the engine having been repaired, was again tried, and the highest rate of speed attained was $21\frac{1}{6}$ miles an hour.

The experiments with the "Saucer" had hardly commenced when one of the cylinders cracked through the bore into the steam port extending along its side, the thickness of the metal having been reduced there by imperfect moulding and boring, to hardly more than $\frac{1}{16}$ of an inch.

This failure led to a considerable waste of steam at each stroke of the piston; notwithstanding which, however, the engine was kept at work until - $22\frac{1}{2}$ miles having been run at full speed. the feed pump stopped working, thus preventing the supply of water to the boiler necessary to continue the experiment. The mean rate of speed for $22\frac{1}{2}$ miles, exclusive of the ends of the stages, was 13.88 miles an hour. The first run of $1\frac{1}{2}$ miles was made at the rate of 17.47 miles per hour which was the highest speed attained on the trial.

The "Rocket" as the only engine which had completed the stipulated distance received the £500 prize, and the results fixed general attention upon the mechanical and commercial practicability of high speed locomotive conveyance.

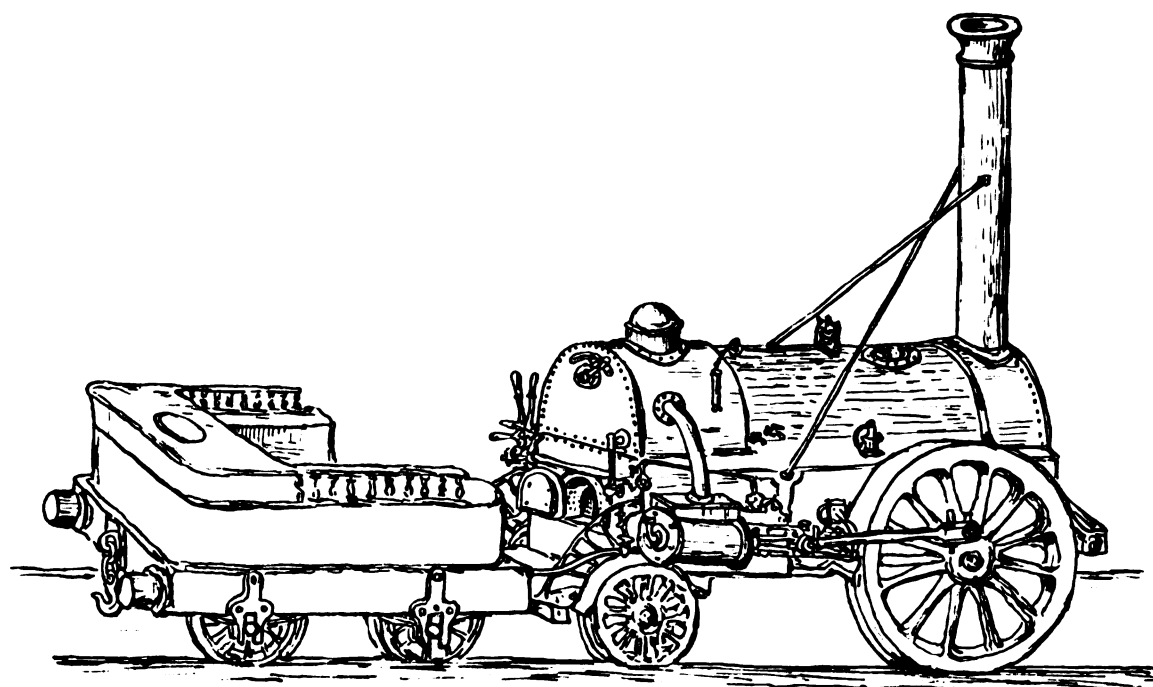
Extract from "Locomotive Engineering and the Mechanism of Railways" by Josiah Alborno Esq



Stephen, son's Rocket. 1829.

The boiler of this engine was cylindrical in form, with flat ends, it was six feet in length, and three feet diameter; the upper part of the boiler was used as a reservoir for steam, the lower half being filled with water; through this lower part, twenty five copper tubes, three inches in diameter, extended with both ends open, one presented to the furnace and the other opening into the chimney. The firebox, two feet long and three feet high attached immediately behind the boiler, was also surrounded by water. The cylinders, two in number, were placed on each side of the boiler in an oblique position, the one end being nearly level with the top of the boiler and the other end pointing toward the centre of the foremost pair of driving wheels, with which the connection was made with the piston rod by a pin to the outside of the wheel.

The Rocket with its load of water weighed only $4\frac{1}{4}$ tons and was supported on four wheels not coupled.

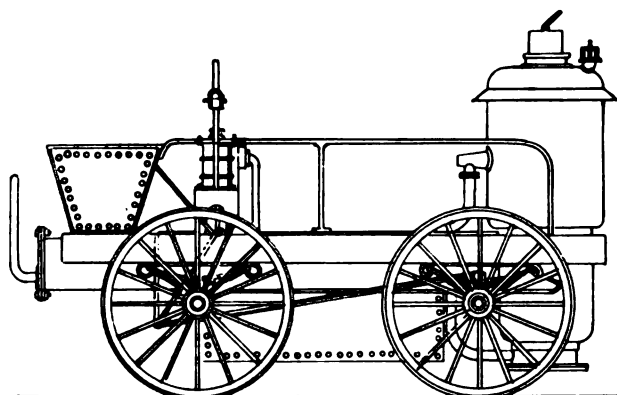


THE ROCKET, 1830.

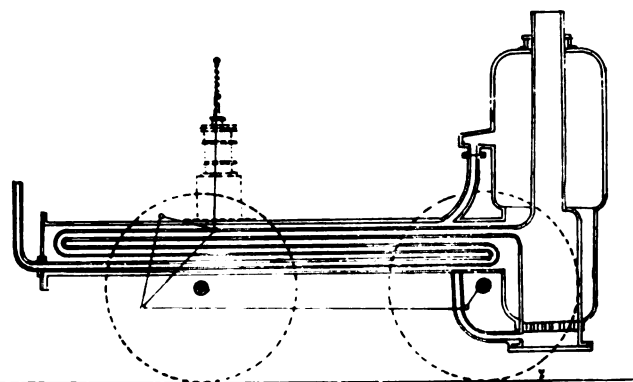
When the Liverpool and Manchester Railway was opened on the 15th of September, 1830, among those present was James Nasmyth, subsequently the inventor of the steam hammer. Mr. Nasmyth was a good freehand draughtsman, and he sketched the Rocket as it stood on the line. The sketch is still in existence.

Mr. Nasmyth wrote concerning it, July 26th 1884 - "This slight and hasty sketch of the Rocket was made the day before the opening of the Manchester and Liverpool Railway, George Stephenson acting as engine driver and his son Robert as stoker, while it remained stationary after some experimental trips."

The Liverpool and Manchester Railway did not open for eleven months after the Rainhill trials and a glance at this sketch will show the astonishing transformation that took place during that period and the conclusion arrived at is that the Rocket of 1829 never worked at all on this line but the engine of 1830 was an entirely new engine. -



Braithwaite and Ericsson's "Novelty," 1829.



Boiler of "Novelty," 1829.

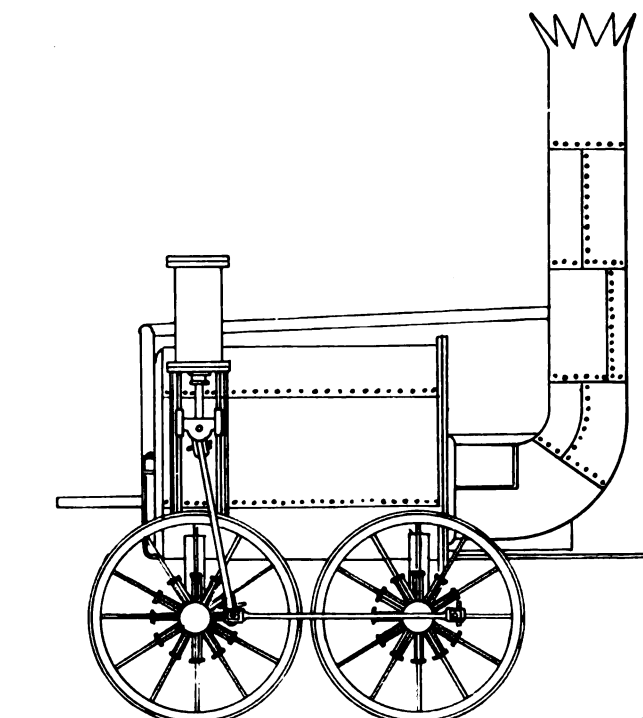
— Braithwaite and Ericsson's "Novelty," 1829 —

The boiler of the "Novelty" comprised an upright cylindrical vessel or firebox and a horizontal barrel 15 inches in diameter and about 12 ft. long. The upright vessel enclosed a firebox surrounded by water and having a fire grate 18 inches in diameter. The ash pit was air tight, the fire being forced by air from a bellows worked by the engine.

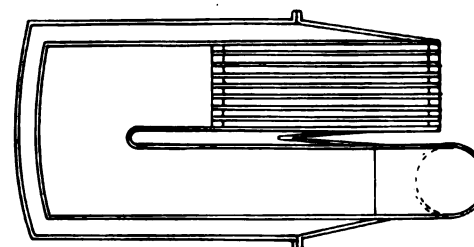
Coke was fed upon the grate through an air tight hopper descending in the center of the upright firebox. The products of combustion were conveyed away through the horizontal barrel by means of a tube folded backwards and forwards, so as to traverse the barrel three times before reaching the chimney. This tube was 4" dia. at the firebox end and 3" dia. where it united with the chimney and its total length was 36 feet.

With the exception of this tube, the horizontal barrel was filled with water, the water level being above the enlarged part of the upright vessel. The area of the fire grate was 1.8 sq. ft. that of the firebox heating surface about 9½ sq. ft. and that of the tube 33 sq. ft.

The two steam cylinders stood vertically upon the framing and were 6" dia. by 12" stroke. The piston rods worked through the top covers of the cylinders, crossheads and side rods being employed to communicate the motion, first to bell crank, whence connecting rods extended to and worked upon cranks in the axle of one pair of wheels. The dia. of each of the wheels was 4 ft. 2.1 in. and coupling chains were provided for, although the two pairs of wheels were not coupled during the trial. The exhaust steam was turned directly into the open air.



Hackworth's "Sanspareil," 1829.

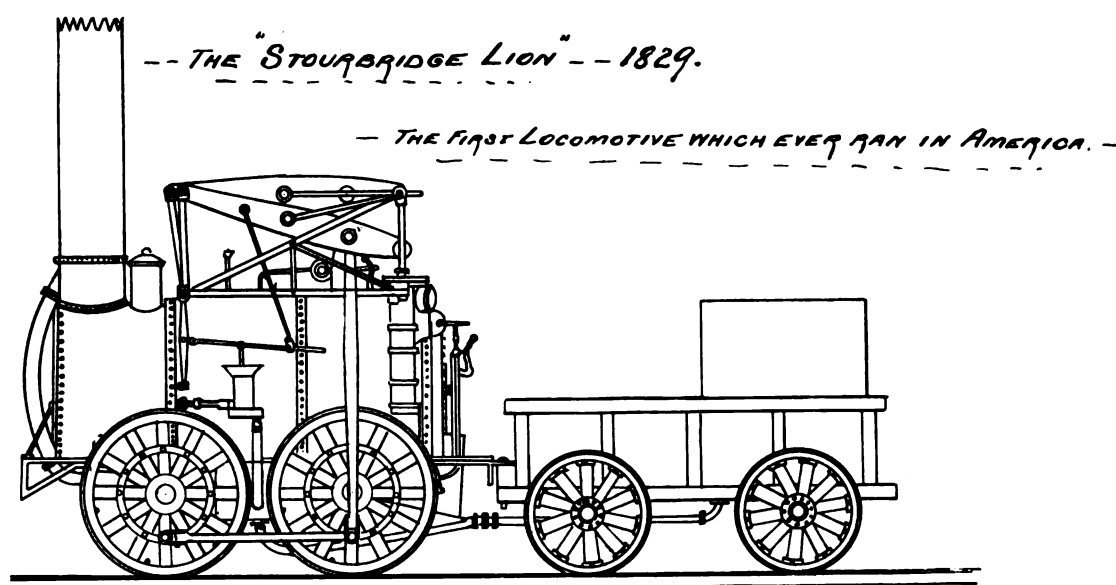


Boiler of "Sanspareil," 1829.

— Hackworth's "Sanspareil," 1829. —

The Sanspareil was a four wheeled coupled Engine and with water in the boiler weighed 4 tons $15\frac{1}{2}$ cwt. thus exceeding by $5\frac{1}{2}$ cwt. the weight allowed by the terms of the competition, to be placed upon four wheels. The tender when charged with coke and water weighed 3 tons, 6 cwt. 3 qrs. The boiler was cylindrical, 4.2" dia. and 16 ft. long and was twice traversed, longitudinally by a return flue, one length of which, enclosing the fire grate was 24" dia., while the other, terminating in the chimney, was 15". Both flues were prolonged 3 ft. beyond one end of the boiler, a suitable water space being made around this part of the flues. The chimney was 15" dia. the fire grate was 5 ft. long, thus presenting 10 sq. ft. of area; that part of the flue answering to an ordinary firebox was 15.7 sq. ft. in extent; while the remaining part of the flue measured 74.6 sq. ft.

The cylinders were vertical and were 7" dia. by 18" stroke. The connecting rods worked upon crank pins, in one pair of wheels, which the others were coupled by rods, all the wheels being 4 ft. 6 in. in diameter. The exhaust steam from the cylinders was sent through pipes into a single contracted nozzle or blast pipe turned upward in the centre of the chimney.

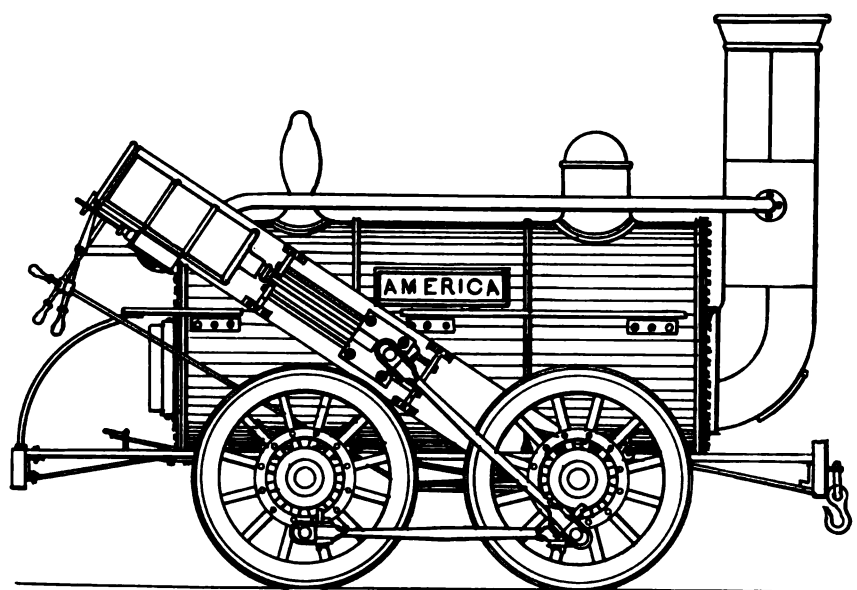


— The Stourbridge Lion, 1829. —

This Engine was built by Foster, Rastuck & Co. of Stourbridge, Eng. for the Delaware and Hudson Canal Co., and arrived in America, May 13th 1829 and was put together at the shops of the West Point Foundry Association, New York, after which it was taken by water to Carbondale where it was tried upon their railroad at Conedale, Pa. making the first trip on the Continent on Aug. 8th 1829.

It was a four wheeled engine, all drivers, with all four wheels connected by pins to the wheels. The boiler was a round cylindrical one; no drop part for the furnace, and the smoke box had a well painted lions head on it.

The cylinders were vertical, placed at the back and each side of the furnace, with grasshopper beams and connecting rods from them to the crank pins in the wheels.



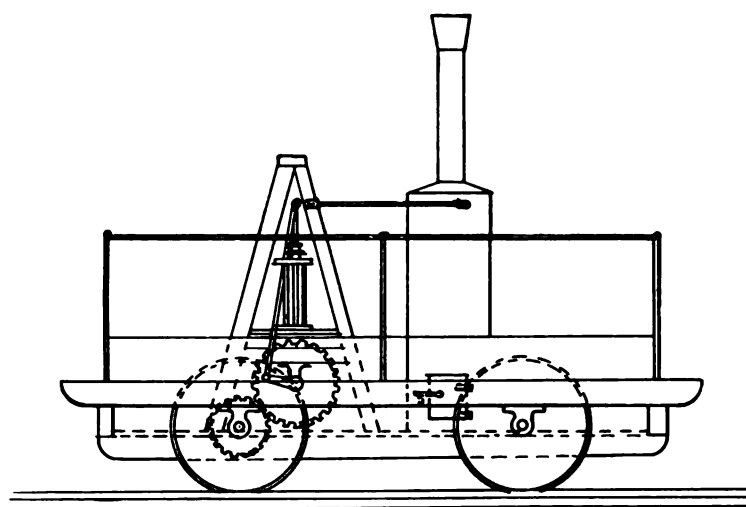
THE "AMERICA" 1829.

Locomotive Engine "America"

In the year 1828 Mr. Horatio Allen was commissioned by the Delaware and Hudson Canal Co. to have built in England for the Company three or four locomotives to be decided by him when in England.

He accordingly made a contract with Messrs. Robert Stephenson & Co. of Newcastle on Tyne for one Locomotive and with Messrs. Foster, Rastrick & Co. of Stourbridge for three more. One of the latter was the "Stourbridge Lion" which made the famous first trip on the Delaware and Hudson Canal Co's line at Honesdale, Pa. on Aug. 8th 1829. The "America" arrived in America Jan. 17th 1829 and the "Stourbridge Lion" May 13th 1829. Therefore while the "Stourbridge Lion" made the first trip on this Continent, the "America" was the first locomotive to arrive.

The dimensions of the "America" were as follows - dia. of boiler 49" length 9' 6", firebox 48 x 36, Cyl. 9" stroke 24" - drivers 48" dia. Size of tubes 19" - no. of tubes 2.



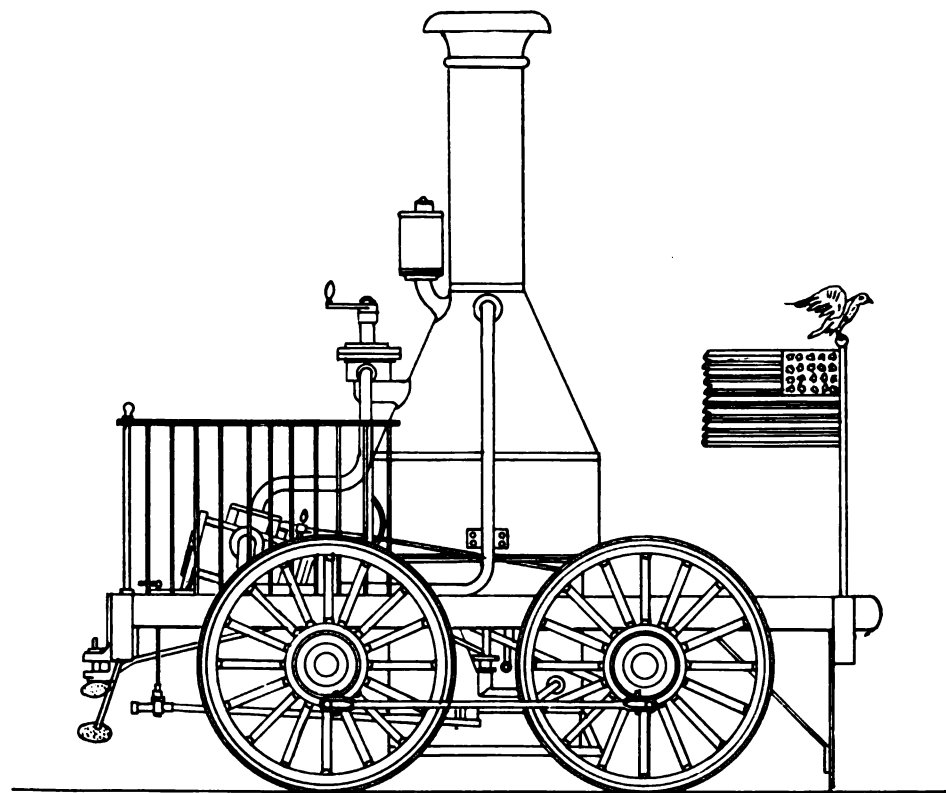
PETER COOPER'S LOCOMOTIVE THE "TOM THUMB," 1830.

~~~~~ *Peter Cooper's Locomotive, Tom Thumb, 1830.* ~~~~~

This Engine was built by Mr. Peter Cooper of New York at the Mount Clare Shops of the B. & O. R.R. at Baltimore and was built to demonstrate its adaptability to a curved road and was the first locomotive for railroad purposes ever built in America.

The first actual experimental trip occurred on Saturday Aug. 28<sup>th</sup> 1830. The boiler sat upright on the car and was filled, above the furnace with vertical tubes. A blowing apparatus driven by a drum attached to one of the car wheels created a draft to keep up steam.

The Engine had one cylinder  $2\frac{3}{4}$  dia.  $\times$   $14\frac{1}{2}$  stroke, the wheels were  $2\frac{1}{2}$  ft. in diameter, and it hauled  $4\frac{1}{2}$  tons at a speed of 12 miles per hour.

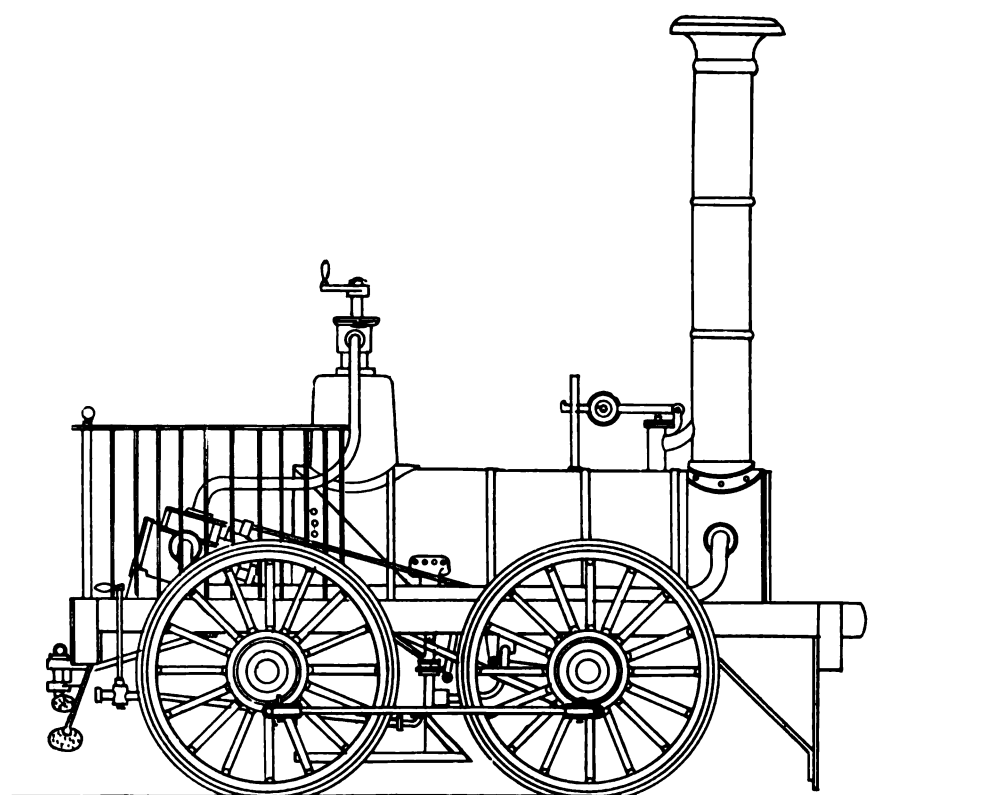


*The Best Friend. 1830.*

*— The 'Best Friend', 1830. —*

*The Best Friend was the first engine to draw a train of cars in America. It was built at the West Point Foundry Shops, New York City, for E. L. Miller and was put on the Charleston and Hamburg Railroad in 1830.*

*It was a four wheeled engine, all four wheels being drivers. Two inclined cylinders at an angle working down on a double crank inside of the frame, the wheels connected on the outside by side rods. The wheels were made with iron hubs, wooden spokes and felloes with iron tires and iron webs and pins in the wheels to connect the outside rods to. The boiler was a vertical one, the boiler set in the centre of the four wheels with connecting rods, running by it, to the crank shaft. The cyls. were 6" dia. by 16" stroke, the wheels 4½ ft. dia. Engine weighed about 4½ tons. The boiler of the engine exploded and was caused by the negro fireman putting his weight on the safety valve to prevent the steam escaping and is the first locomotive boiler explosion on record in America.*



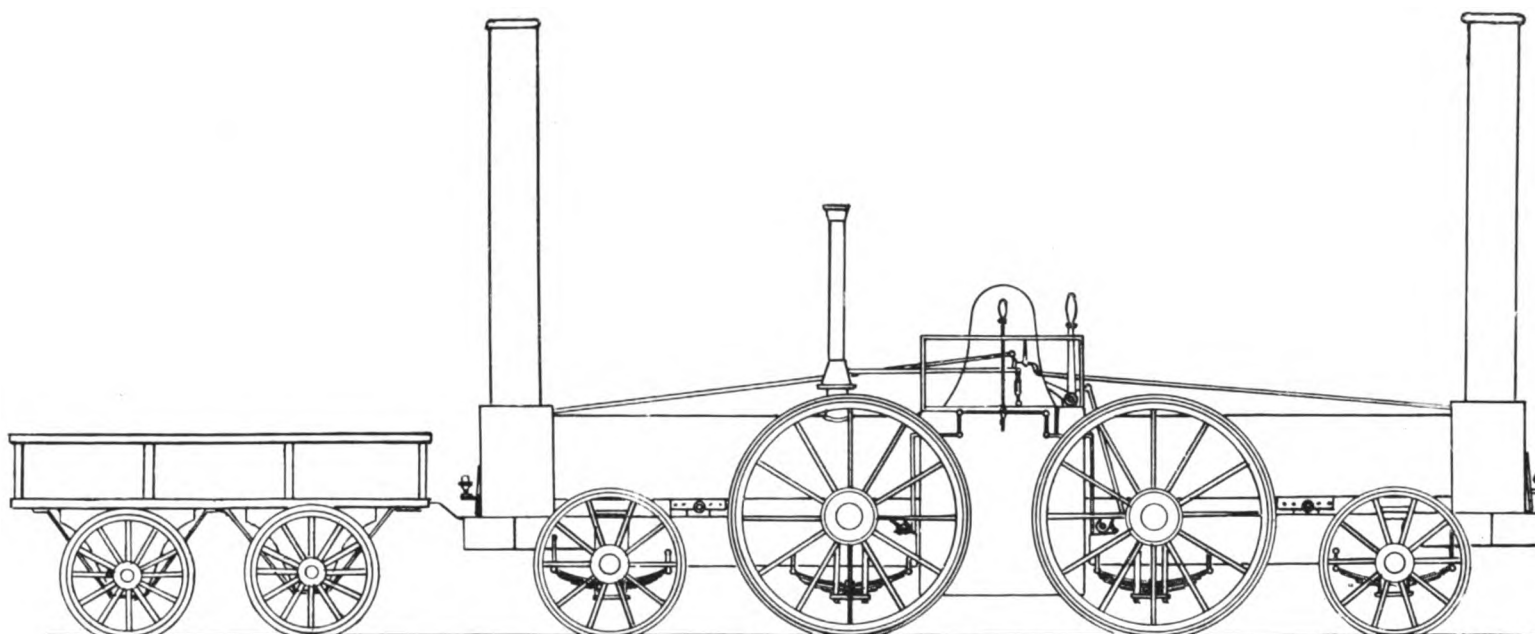
*The West Point. 1830-31.*

— *The "West Point," 1830-31.* —

*The West Point was the second engine to draw a train of cars in this country and was built at the West Point Foundry Shops, New York City and put on the Charleston and Hamburg Railroad in the winter of 1830-31 at Charleston, S. C.*

*The rails were of wood topped with iron.*

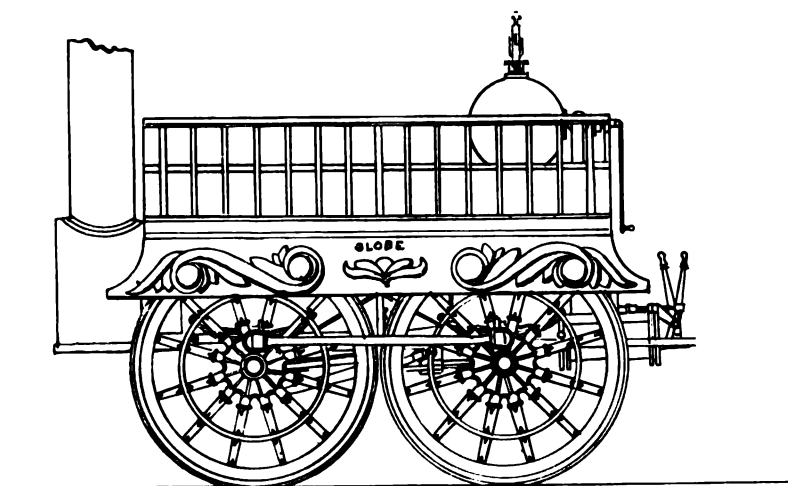
*This Engine was similar to the Best Friend except that it had a horizontal tubular boiler.*



*~ The "South Carolina", 1831. ~*

*This Engine was built at the Shops of the West Point Foundry Association, New York, for the South Carolina Railroad in 1831, from the designs of Horatio Allen, and was the first eight wheel engine built in America.*

*The Engine had a vibrating truck at both ends with cylinders thereon. It had a double ended boiler with firebox in the middle with flues from firebox to each end of the boiler and had double smoke-box and double stack, with fire door on side of firebox and had flexible steam and exhaust pipes.*

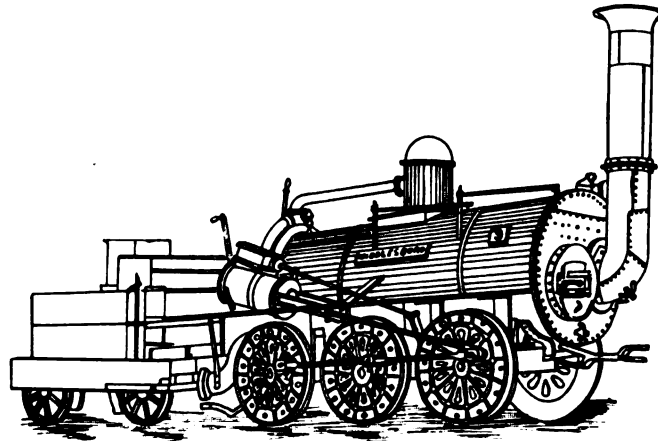


Hackworth's "Globe," 1830.

— Hackworth's "Globe," 1830. —

The boiler of this engine was of the single flue variety, the fire grate being placed in the flue, in the front end of which, a number of water tubes were fixed diametrically across, and in such order as to deflect the heated products of combustion into a spiral course. These tubes were subsequently removed, as they soon choked with matter deposited from the water.

The wheels were four in number, 5 ft. in dia. and coupled. A copper steam dome was placed upon the boiler and from this feature, which appears to have been original at the time the engine received its name - the "Globe". The driving axle was double cranked, the cranks being at right angles to each other and the cylinders were placed horizontally and side by side. The two eccentrics were loose upon the driving axle and were reversible by a single lever. The Globe is stated to have attained a speed of 50 miles an hour and was constantly employed in the passenger traffic of the Stockton and Darlington line down to 1839 when the boiler exploded at Ellidlesboro-on-Tees.



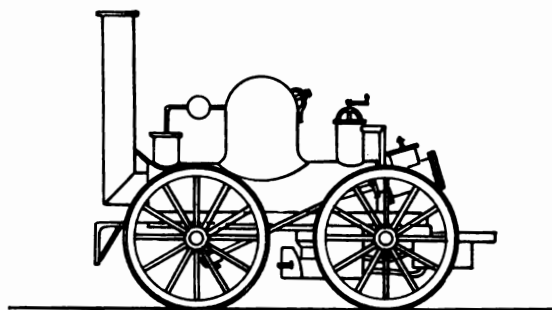
Stockton and Darlington Engine, 1830

— Stockton and Darlington Engine, 1830. —

The Stockton and Darlington Engines constructed between 1830 and 1834, together with Hackworth's "Royal George" of 1827, were the earliest six coupled engines made and they invariably had inside frames.

This Engine, required a tender at each end although but one is shown.

The drivers were of a peculiar design by Timothy Hackworth.



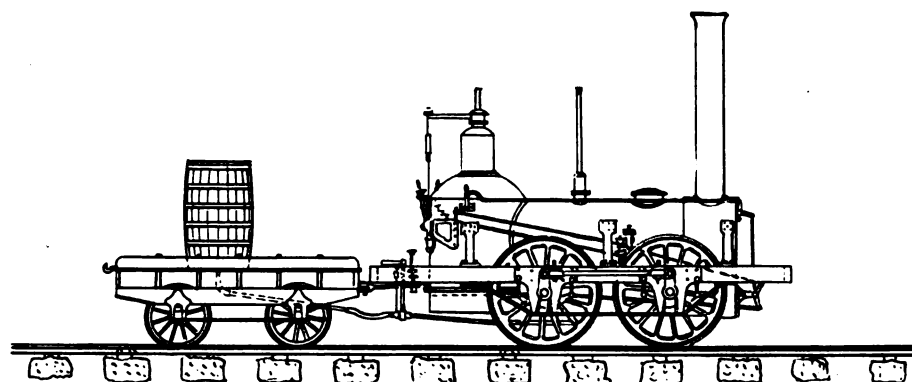
De Witt Clinton. 1831.

~ The 'De Witt Clinton', 1831. ~

This Engine was the third built by the West Point Foundry Association, New York for the Mohawk and Hudson River Railroad in 1831.

It had two cylinders  $5\frac{1}{2}$ " dia. by 16" stroke, four wheels all drivers,  $4\frac{1}{2}$  ft. dia., with all the spokes turned and finished. The spokes were wrought iron, hubs cast iron, and the wheels tired with wrought iron, inside crank and outside connecting rods to connect all four drivers; a tubular boiler with drop furnace, two fire doors one above the other, copper tubes  $2\frac{1}{2}$ " dia. and about 6 ft. long.

Cylinders on an incline and the pumps worked vertically by bell crank. This Engine weighed about  $3\frac{1}{2}$  tons without water and would run 30 miles an hour with 3 or 5 cars on a level with anthracite coal and was the first engine in the State of New York on a railroad.



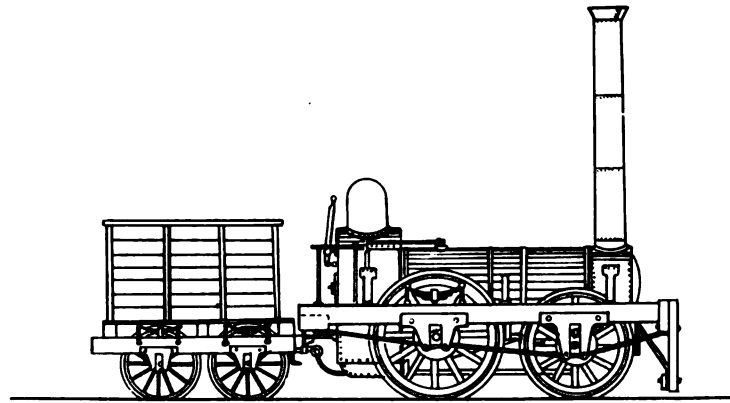
*The John Bull, 1831.*

*This Engine was built by George Stephenson at Newcastle-on-Tyne, England, for the Camden and Amboy Railroad, and arrived in America in August, 1831; and began running on the 12<sup>th</sup> of November of the same year at Bordentown N. J.*

*The weight of the engine was about 10 tons; boiler 13 ft. long and 42" dia., cylinders 9" dia. by 20" stroke; driving wheels 4.6 dia. made with cast iron hubs and wooden spokes and felloes. The tires were wrought iron  $\frac{3}{4}$ " thick, depth of flange  $1\frac{1}{2}$ "; gauge of track 5 feet.*

*This engine was the first in use in the State of New Jersey, and is still in existence, having been deposited in the Smithsonian Institute at Washington by the Pennsylvania Railroad Company.*





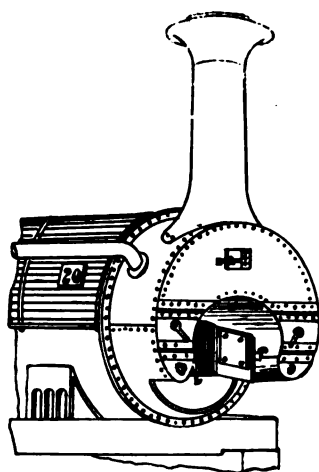
"Old Ironsides" 1832.

### *— The 'Old Ironsides', 1832. —*

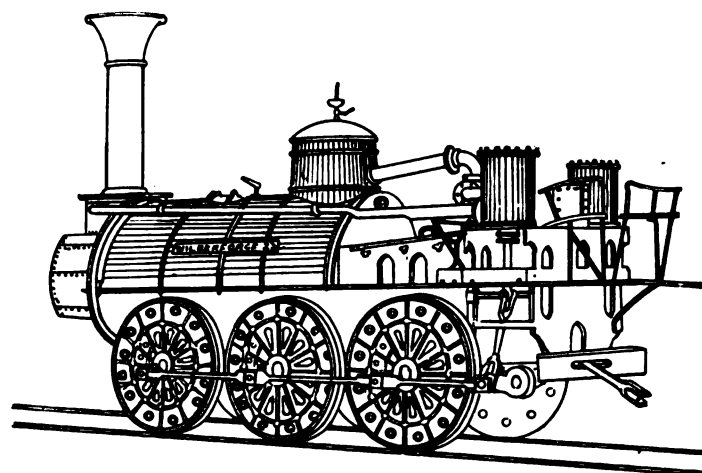
In November, 1832 M. W. Baldwin, the founder of the celebrated Baldwin Loco. Works in Philadelphia built this locomotive named the "Old Ironsides" for the Philadelphia, Germantown and Norristown Railroad, and did good service for 26 years.

It was a close copy of the English Engines used on the Newcastle and Fenchington Railroad (now part of the Phila. Wm. & Balto. Railroad) with a few minor improvements.

It was a four wheeled engine dia. of drivers 54" placed in front of the firebox; the front wheels were simply carrying wheels 45" dia. The cylinders were 9½" dia. by 18" stroke and were attached to the smoke box. The boiler was 32" dia., 32 tubes 7 ft. long, Weight of Eng. in working order, 5 tons. Cost ready for road \$3500.00.



Smoke Box and Fire Door.



Stockton and Darlington Engine, 1832-36.

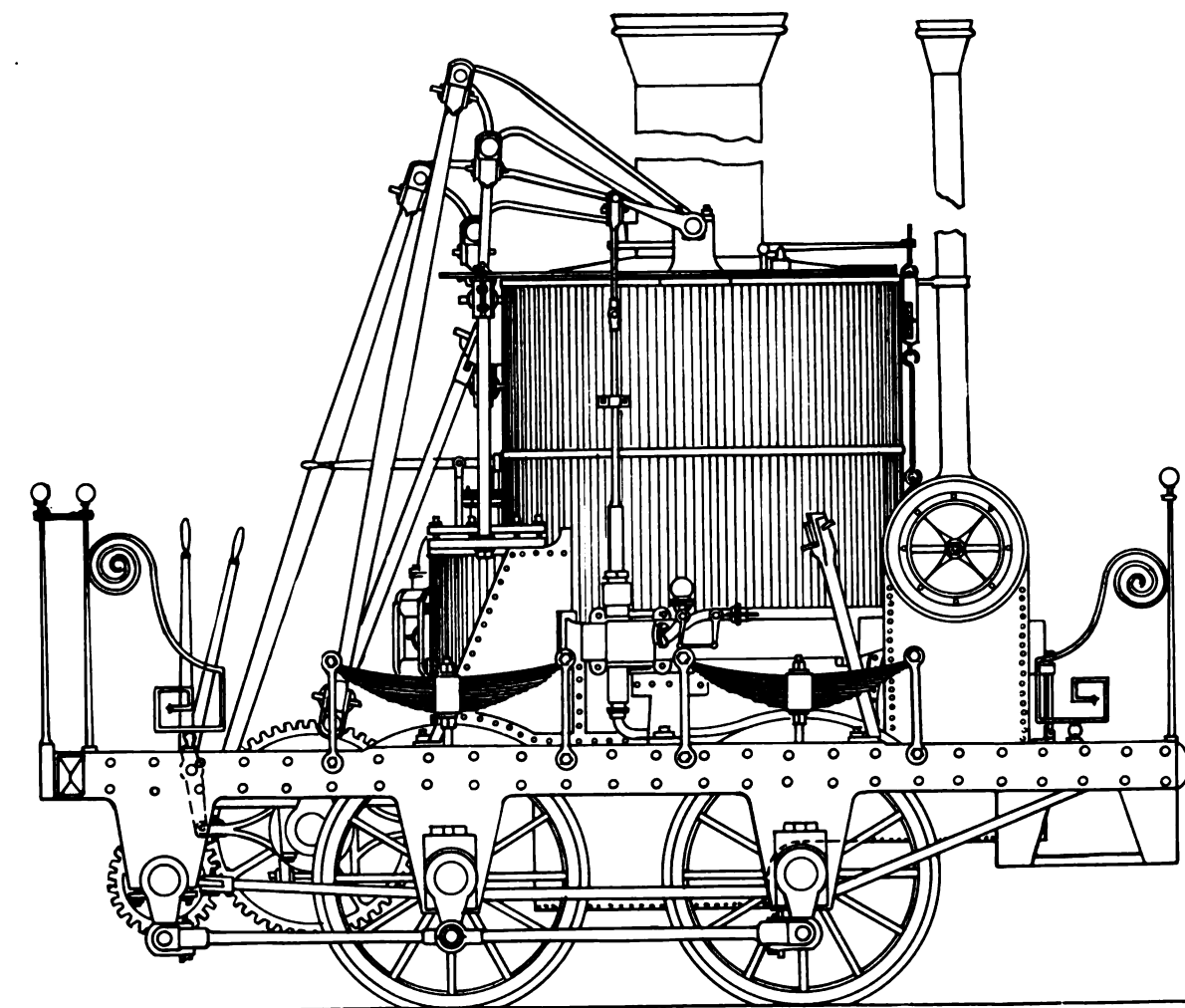
### Stockton and Darlington Engine, 1832-36.

This class of engines were in extensive use on the Stockton and Darlington line in 1832 & 1836 and were built by both Hawthorn and Stephenson.

They had boilers 13 ft. long, 44" dia., the fire place was in a tube 29" dia. and 9 ft. long, the fire door being at the same end as the stack. At the end of this tube farthest from the stack the flame was divided and the heat returned through a group of copper tubes on each side of the fire place.

The smoke box received the products of combustion from both groups of tubes and communicated with the stack in the usual way. There were 53 tubes on each side of the fire tube, their length being 4 feet and outside diameter  $1\frac{3}{4}$ " The arrangement of smoke box is shown in detail.

These Engines required a tender for coal at one end and one for water at the other.

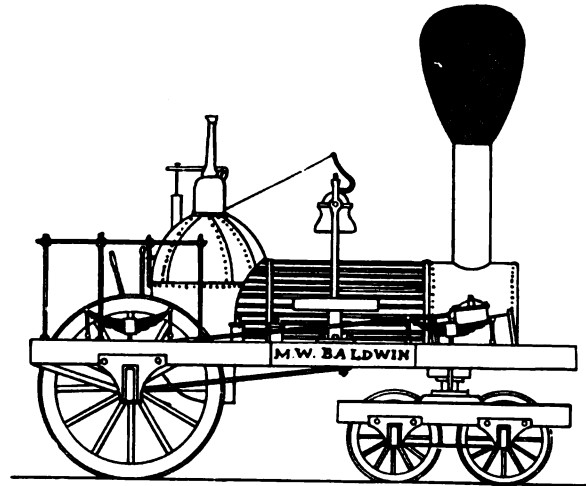


~ ~ ~ *The Atlantic*, 1832. ~ ~ ~

*This Engine was built by Messrs. Davis and Gartner of York, Pa. for the Baltimore and Ohio Railroad, and was set at work in Sept. 1832, and hauled 50 tons from Baltimore, 40 miles, over gradients having a maximum rise of 37 feet per mile and on curves having a minimum radius of 400 feet at a rate of 12 to 15 miles per hour.*

*In this Engine, "grasshopper" beams were employed with spur gearing to communicate the motion to the wheels. The engine weighed 6½ tons.*

*The waste steam was not discharged directly up the stack, but against the blades of the fan in such a manner as to cause it to revolve rapidly and thus produce the strong blast of air necessary for the combustion of anthracite coal.*

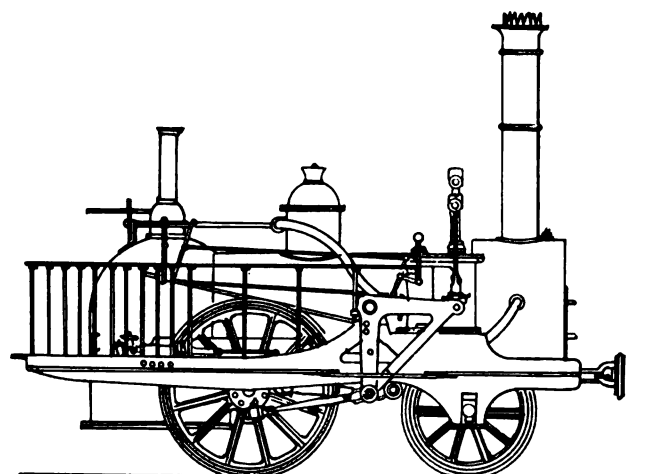


Baldwin's Engine, 1833.

~ Baldwin's Engine, 1833, ~

This Engine, built by Baldwin next after the "Ironsides" was arranged with a 4 wheeled swiveling truck or bogie.

It had outside cylinders, but the connecting rod worked upon a crank inside of the wheels, the framing being wholly outside of the wheels. This peculiar form of crank axle patented by Mr. Baldwin Sep. 10-1834, was known as the "half crank" and was long employed by him.



Richard Roberts' Locomotive, 1833.

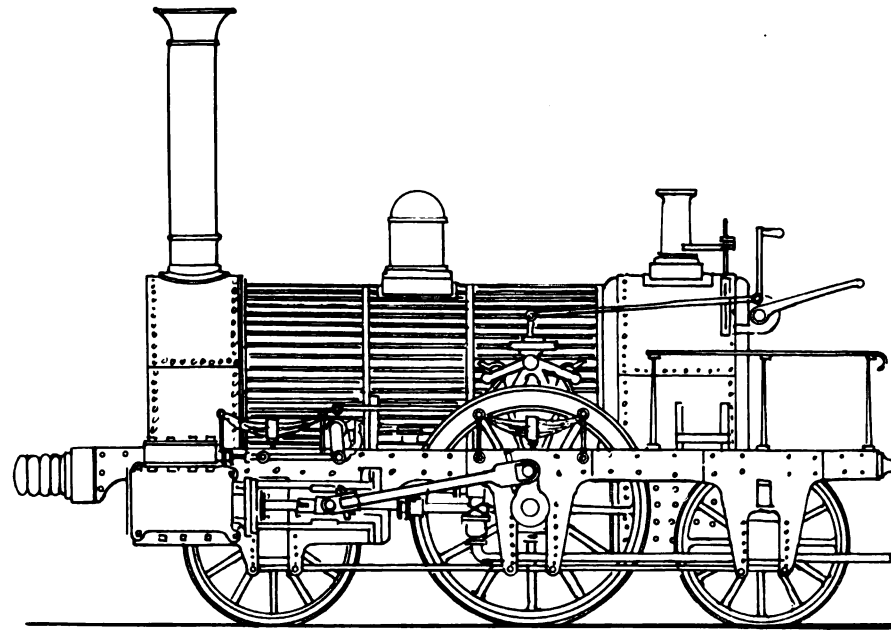
~ Richard Roberts' Locomotive 1833. ~

These Engines were built by the firm of Sharp, Roberts and Co., afterwards Sharp, Stewart & Co. Limited,.

These engines had outside vertical cylinders 11" dia., the piston rod working through the top cover and connected by a cross-head and pair of side links to a bell crank lever made in pairs, from which the power was transmitted to the driving wheels.

The slide valves were cylindrical and of a kind patented by Mr. Roberts in 1832.

One of these engines ran on the Liverpool and Manchester line and three on the Dublin and Kingstown Railway in 1833.



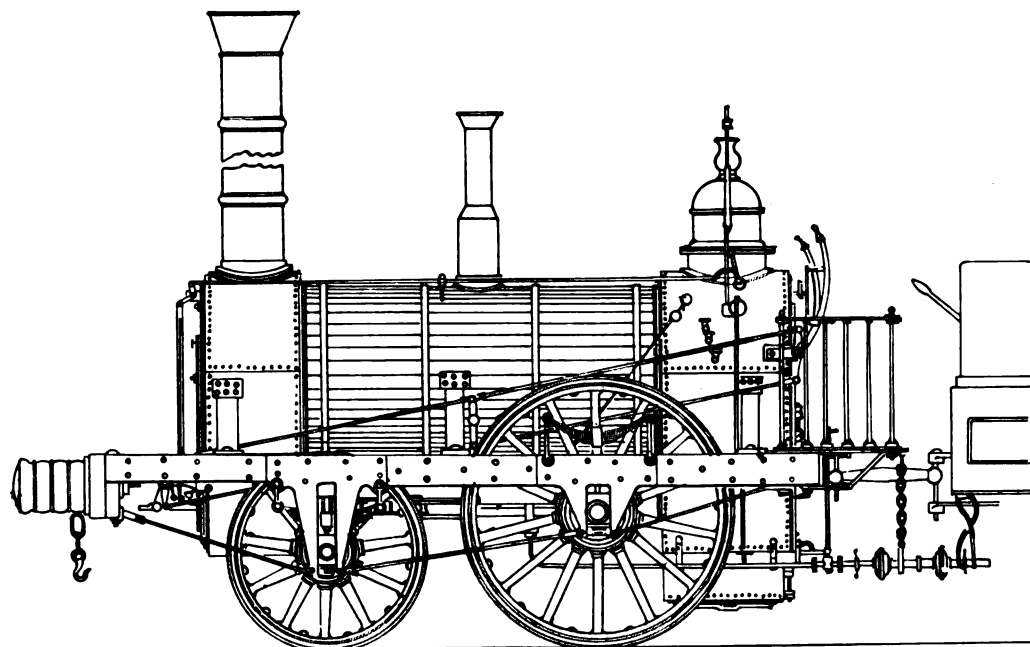
Forrester's Locomotive, 1834.

### — Forrester's Locomotive, 1834. —

In 1834 Messrs. Geo. Forrester and Co. of Liverpool completed an engine which included some important novelties of arrangement.

It was a 6 wheeled engine with outside horizontal cylinders. It had, however, outside frames and the drivers were driven by connecting rods, acting on cranks, keyed upon the axles at a considerable distance beyond the face of the wheels.

The centre lines of the cylinders were thus spread widely apart and as the wheels were not counterbalanced, the unsteadiness even at moderate speed was very apparent.

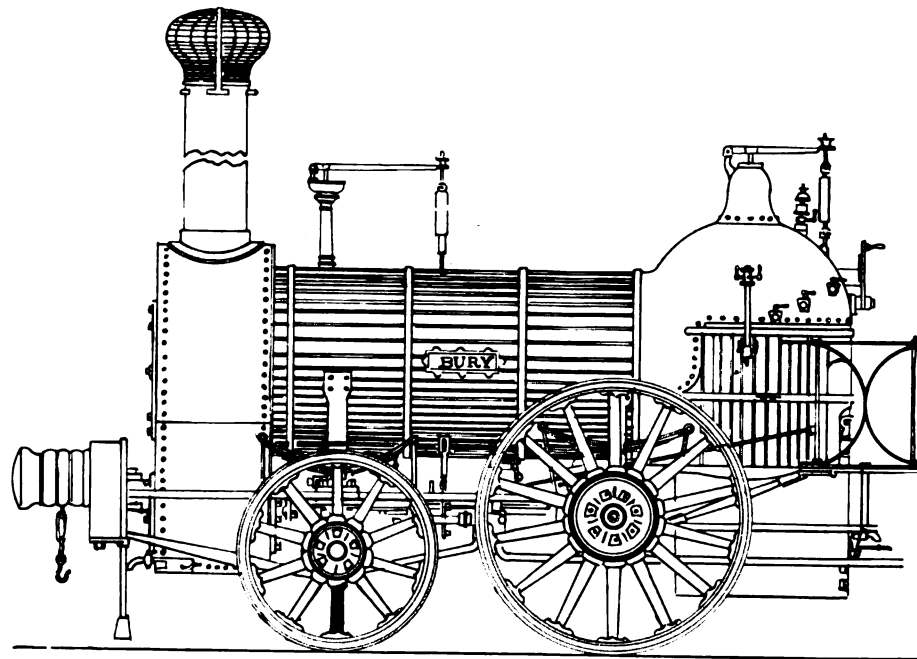


Passenger Locomotive by Fenton, Murray, & Jackson, 1834. General type of the "Planet" class.

*- Passenger Locomotive by Fenton, Murray and Jackson, 1834 -*

The Locks and Canals Co. of Lowell, Mass. commenced the construction of Loco's. after the model of the 'Planet' in 1834, and supplied many engines of that class to the railways of New England. The first locomotive made at Lowell was "The Patrick" (named for Patrick Tracy Jackson Esq) placed upon the Boston and Lowell Railroad June 24<sup>th</sup> 1835.

This Engine and the "Lowell", "Concord", "Nashua", "Bedford" and "Suffolk" on the same line measured as follows, Cyls, 11" dia. 16" stroke, 5 ft. driv. whls., 3 ft. leading whls., Boiler 34" dia., containing 66 copper tubes, 2 1/4" out. dia. 6' 10" long; Fire Grate 23" long, 3' 6" wide, Firebox 3' 1/2" to 3' 3" deep; grate area 6.71 sq. ft. Firebox surface (in different engines) from 36.8 to 38.36 sq. ft., external surface of tubes 265.6 sq. ft., Induction ports 6" long, 1 1/8" wide, eduction port 1 1/2" wide; - two blast pipes, each 1 1/2" only in dia. at the nozzle; Weight of Engine in working order, 10 tons, 6 cwt., 3 qrs. - Weight on driving wheels 6 tons, 9 cwt., 1 qr. 9 lbs., Weight of Tender loaded, 6 tons, 13 cwt., 1 qr. 6 lbs. These Engines burned wood.



Bury's Locomotive, 1835. Originally designed in 1829.

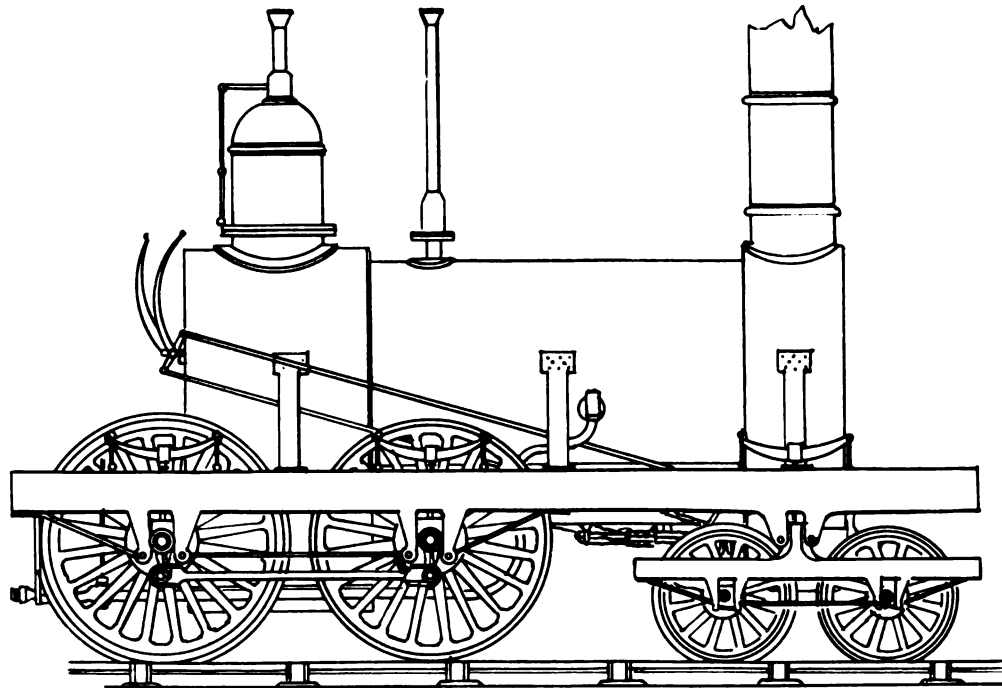
### *~ Bury's Locomotive, 1835 ~*

*These Engines were brought out by Mr. Jas. Kennedy, then directing the factory of Mr. Bury of Liverpool, and were favorably known for their compact structure and good working qualities.*

*These Engines had drivers 5 ft. in dia. and had the round backed and dome topped firebox.*

*Several of the Engines came to America and until quite a late day the same general structure was retained by American Locomotive builders.*



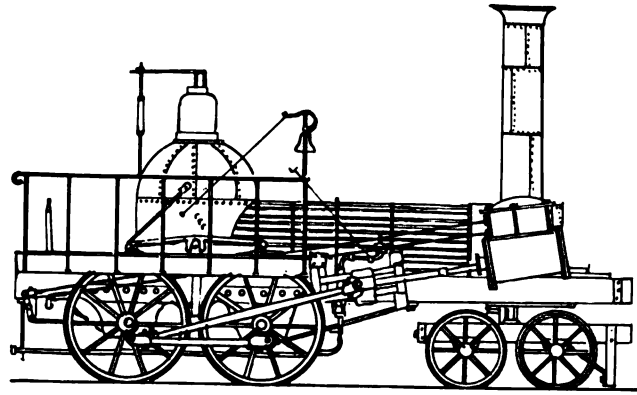


~ ~ ~ Campbell's "Eight Wheeler", 1836. ~ ~ ~

In 1836, Henry R. Campbell, Chief Engineer of the Philadelphia, Germantown and Norristown Ry., patented the combination of the ordinary truck or bogie with two pairs of coupled drivers, one pair being in front and one back of the firebox as in the ordinary coupled passenger engine of today. This Engine was contracted for by Jas. Brooks of Phila. and began on May 16<sup>th</sup> 1836 and finished May 8<sup>th</sup> 1837.

This was the first eight wheel engine of this type and from it the standard American locomotive of today takes its origin.

This engine lacked the essential feature of the equalizing beam between the drivers as it had nothing but the ordinary elliptic springs over each journal and had no good means of equalizing the weight on the driving wheels so as to meet the various undulations of the track.



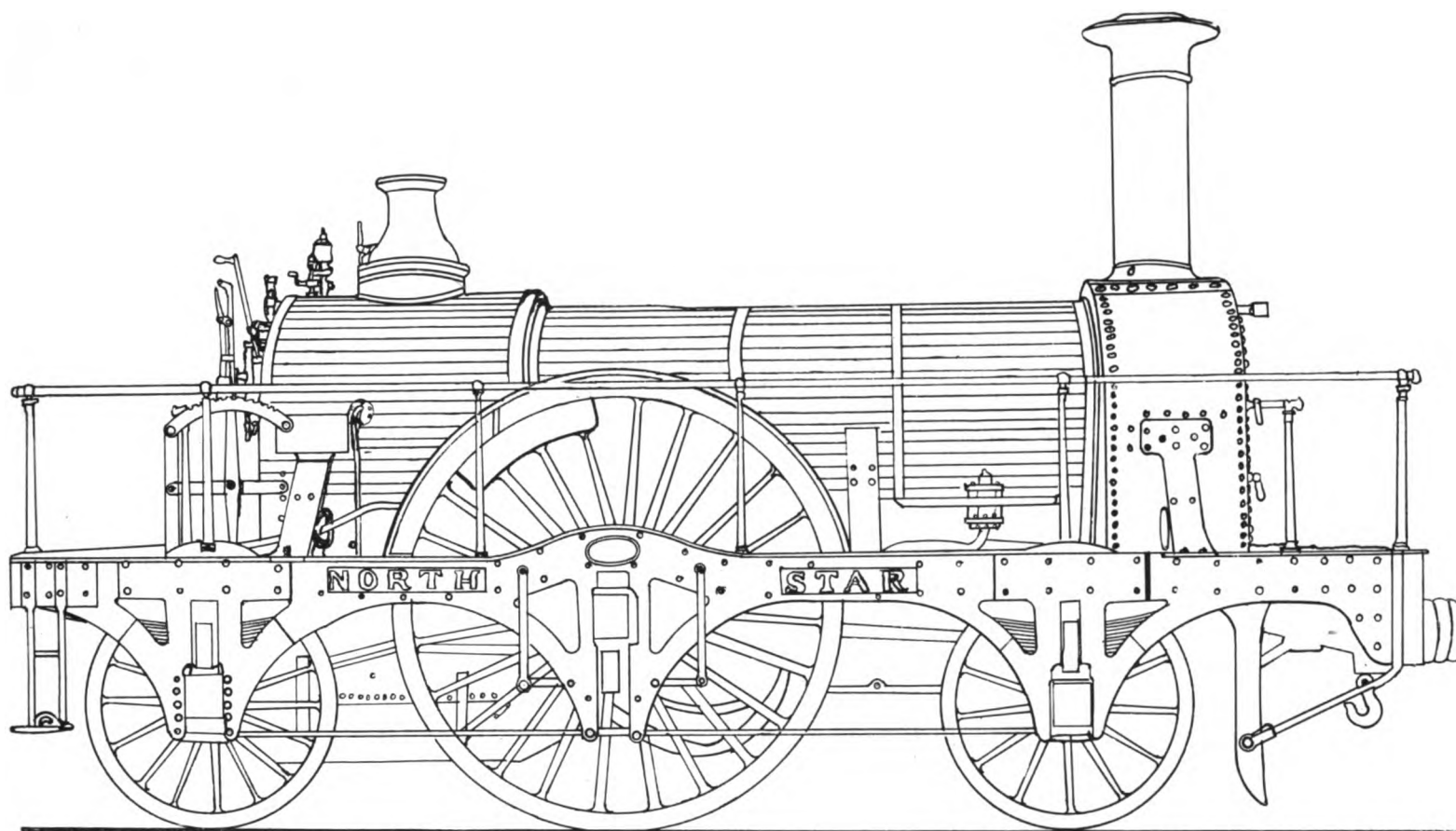
Eastwick and Harrison's Engine, 1837.

— Eastwick and Harrison's Engine, 1837. —

This Engine was first worked on the Reading Railroad early in 1839. It had 12" cyls., 18" stroke, and four coupled driving wheels 3 ft. 8 in. in dia. Its whole weight was 12 tons 13 cwt. & 1 gr. of which 8 tons 1 cwt. 2 grs. were available for adhesion.

With steam of 90 lbs. press. per sq. in. the engine drew a load of 265 tons, including the tender up a gradient varying from 27 ft. to 38 ft. per mile.

This Engine was built by Eastwick and Harrison of Philadelphia who added compensating levers or equalizers placed so that the weight of the eight wheeled engine was carried upon four points upon the framing and may be considered as the first of a class which has since been generally adopted, not only in America, but on the Continent of Europe and, to a considerable extent in Great Britain.

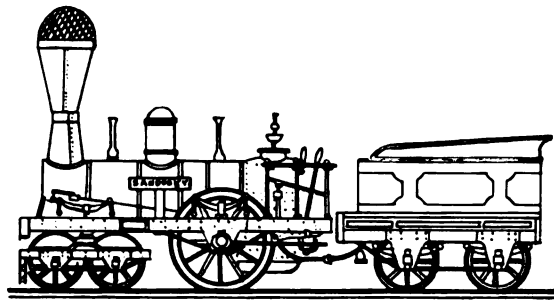


HISTORICAL LOCOMOTIVE—THE NORTH STAR.

*This Engine was built in 1837, from a design of Sir Daniel Gooch, and was built by Messrs. Robert Stephenson and Co. and was one of the first on the Great Western Railroad. It commenced working in Jan'y. 1838 and ran continuously until Dec. 1870, making a mileage of 429,000 miles.*

*The drivers were 7 ft dia and were of wrought iron with round tapering spokes, being  $2\frac{3}{4}$  in dia. at the hub and  $1\frac{7}{8}$  in at the rim and set "slaggering" in the hub. The front and back wheels were 48 in dia. Cylinders 16 x 18 stroke.*

*This Engine is now carefully preserved at Swindon, the headquarters of the Railroad Company.*

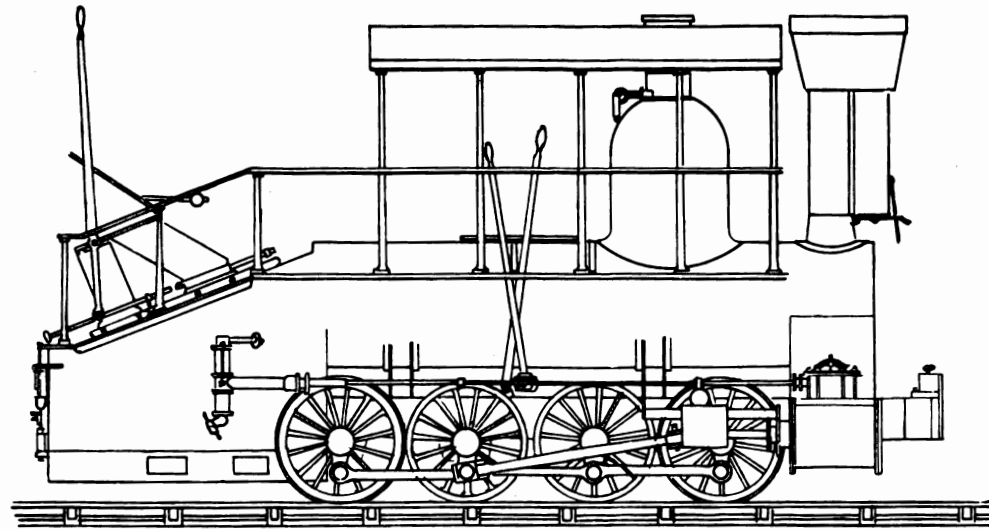


~ The "Sandusky", 1837 ~

This Engine was the first one built by the firm of Rogers, Ketchum and Grosvenor of Paterson, N.J. and was tried on Oct. 6<sup>th</sup> 1837 between Paterson and Jersey City and was bought by the President of the old River and Lake Erie Railroad and arrived at Sandusky Nov. 17. 1837, at which time, not a foot of track had been laid. It was used in the construction of the road until April 11<sup>th</sup> 1838, when it began making regular trips in passenger service.

Cylinders 11" dia. by 16" stroke, drivers 4' 6" dia. truck wheels 30" dia.

Driving wheels with hollow spokes and rims were first used on this engine and the counterbalancing of same first introduced.



Ross Winans Coal Burning Goods Engine, 1844 to 1854.

— Ross Winans Coal Burning Engine 1844 to 1854. —

These engines were built by Ross Winans of Baltimore Md. and were the prevailing class employed on the Balto. & Ohio R.R. and on the Reading Railroad, up to within a quite recent period for freight service.

As early as 1844 these engines had taken the form shown above, the object being to get great tractive force at a slow speed, and for this reason large cylinders and small driving wheels were used - the cylinders being 17" dia. and 22" stroke and the wheels 46" diameter.

The driving wheels were cast iron with chilled rims, the front and back pairs only being flanged.

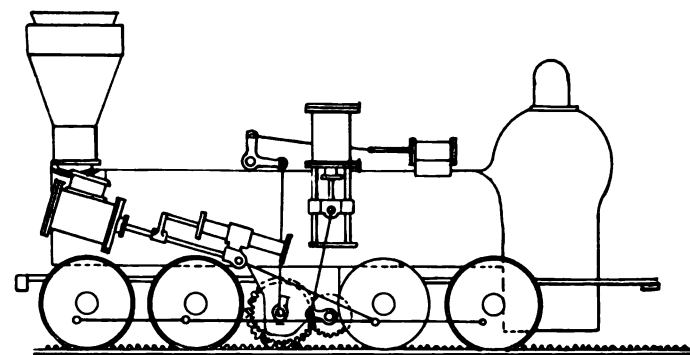
The firebox was 84" long and 42" wide presenting  $24\frac{1}{2}$  sq. ft. of grate surface, and had not only doors at back, but a self feeding hopper on top. The weight of these engines was 54 200 lbs. in working order.

MADE BY MR BALDWIN OF PHILADELPHIA,  
 8 COUPLED DRIVERS WORKED BY 2 CYLS. INCLINED  $\cdot 17 \frac{1}{22}$   
 RACK RAIL LAID MIDWAY OF THE RAILS OF THE LINE  $10''$  WIDE - PITCH OF TEETH  $\cdot 4$   
 2 VERTICAL CYLS.  $17 \times 18$  WITH PISTONS WORKING DOWNWARDS  
 CONNECTED BY CRANKS TO PINION BENEATH BOILER. PINION  
 WORKED INTO A WHEEL TWICE ITS OWN DIA. AXIS OF THIS  
 WHEEL BEING SUPPORTED IN BEARINGS IN THE LOWER ENDS  
 OF A PAIR OF CONNECTING RODS, WHICH THROUGH THE  
 INTERVENTION OF A BENT LEVER ACTED UPON BY THE  
 PISTON IN A HORIZONTAL CYL.  $10''$  DIA. MIGHT BE RAISED  
 OR LOWERED ACCORDING TO THE NECESSITY OF ENGAGING  
 OR DISENGAGING THE RACK PINION WITH OR FROM THE  
 RACK RAIL.

FIVE CYLINDERS IN ALL.

112 TUBES,  $2''$  DIA  $\times$  17 FEET LONG.

WEIGHT OF ENG. EXCLUSIVE OF TENDER UPWARDS OF 30 TONS



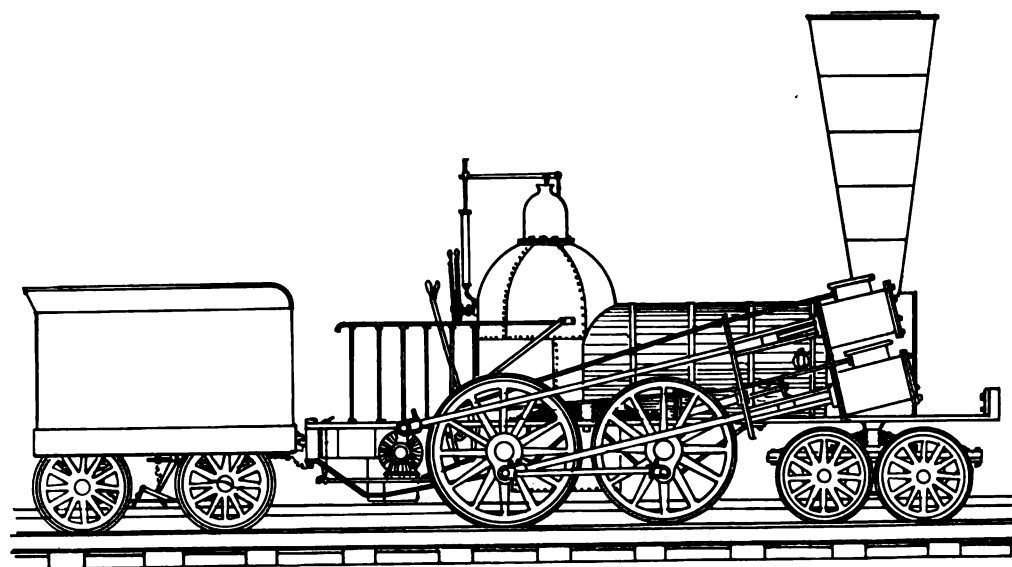
Locomotive for Rack Rail, Madison and Indianapolis Railway,  
 1848.

— Locomotive for Rack Rail, Madison and Indianapolis Ry. 1848. —

In 1848 the rack rail was adopted on an incline  
 of 1 in 17 on the Madison and Indianapolis Ry.

This incline rose from the north bank of the Ohio River  
 at Madison, and was about five eighths of a mile in  
 length.

Two engines as shown above called the "John Bright"  
 and the "John Brough" were built by Matthias W. Baldwin  
 of Philadelphia for working on that part of the line.  
 The dimensions and description are given above.

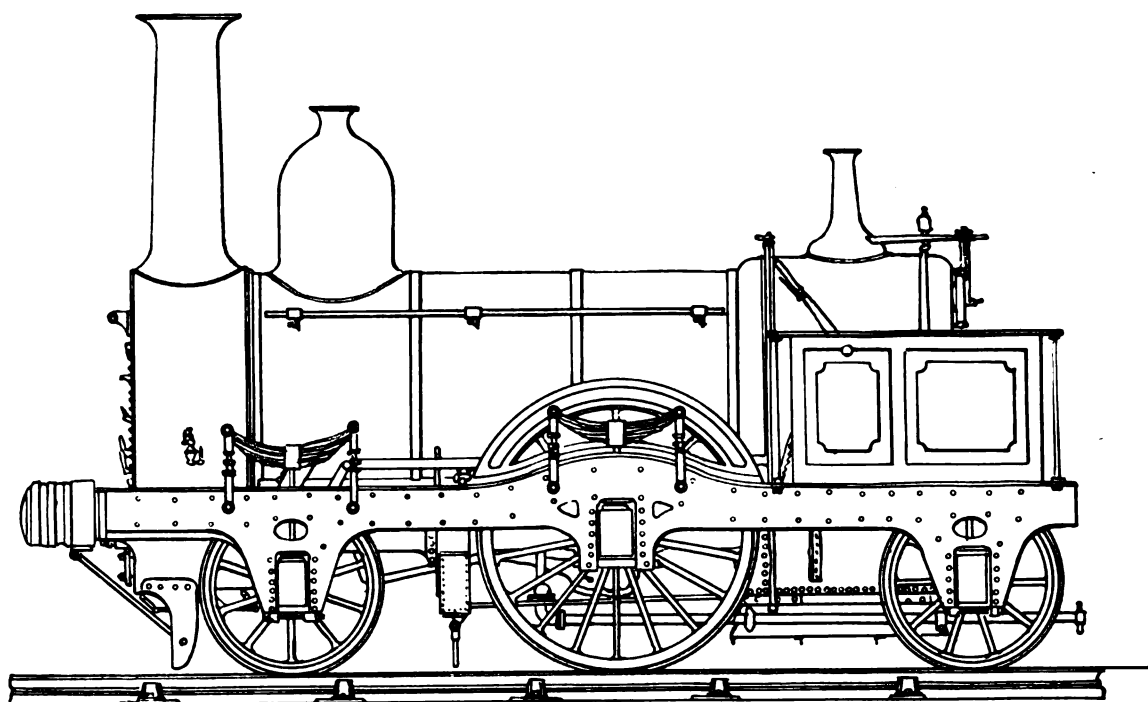


G. E. Sellers' Locomotive for "Middle Rail," 1847.

--- Geo. E. Sellers' Locomotive for "Middle Rail," 1847. ---

This engine had the usual pair of cylinders, working coupled driving wheels on the level and moderately inclined portions of the line while, by means of an extra pair of cylinders, and a corresponding pair of wheels working on vertical axes and gripping a middle rail on steep inclines, the effective adhesion might be increased to almost any extent. The method of working the gripping wheels from the upper pair of cylinders and, through bevel gearing will be seen on drawing.

Each pair of cylinders had its own throttle valve.  
Mr. Sellers constructed 4 or 5 of these engines at Philadelphia for the Panama Railroad, but were never used.



Sharp, Brothers, and Co.'s Engine, 1847.

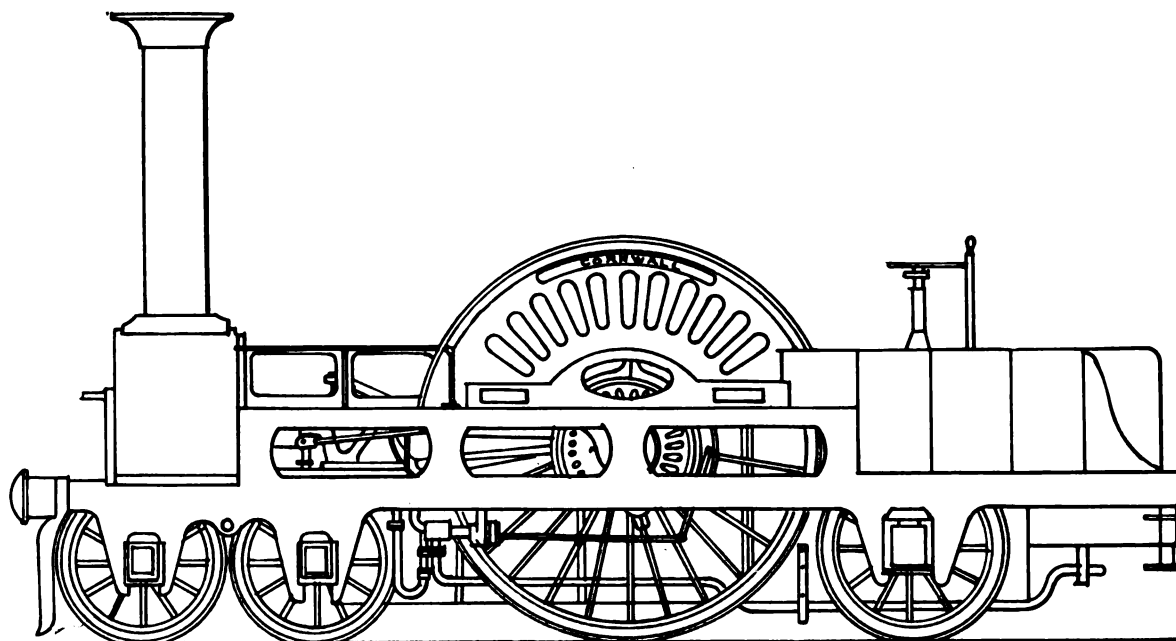
— *Sharp, Roberts and Co's Engine, 1847.* —

These Engines, made by Messrs. Sharp, Roberts & Co. and by their successors, Sharp, Brothers and Co., represent, what for many years was the favorite pattern upon English Railways. —

The position of the dome, near the stack, gives the engine a hump backed appearance. This was done as at that time there was a difference of opinion as to the best place for the dome it having been found that when the steam was taken directly over the firebox, as in most of the earlier engines, a great deal of water was carried over into the cylinders.

This result was no doubt due in a great measure to the fact that the steam room and the area of water level from which the steam rose, were <sup>insufficient, as must be said</sup> near the point where the steam was taken, the water was always in a state of agitation when the engine was working.





LOCOMOTIVE "CORNWALL."

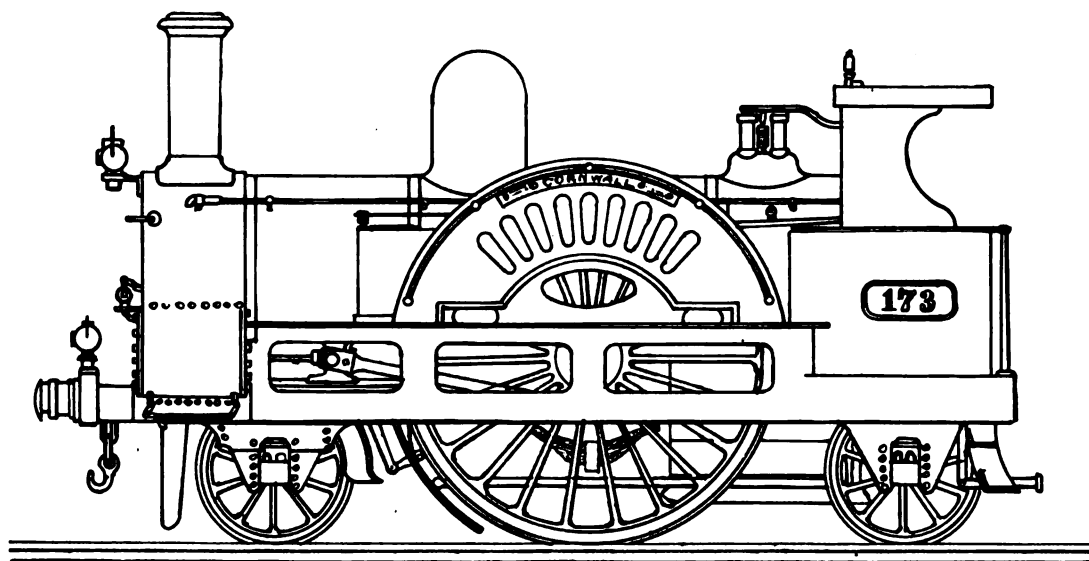
*As originally designed by J. Trevellick and built for the London & Northwestern Railway in 1847.*

### — LOCOMOTIVE "CORNWALL" —

*This Engine has been, for some time past the engine with the largest driving wheels in existence.*

*She was designed by J. Trevellick, and built in 1847, and was shown in the Exhibition of 1851. Fig. 1 represents the engine as originally constructed. The boiler, it will be seen, went under the driving axle, and she ran on eight wheels; but Mr. Ramsbottom rebuilt and altered her, in 1862-63, to her present state, as shown in fig. 2. with the exception of the cab, which has since been added by Mr. Webb. Dimensions; Cylinders  $17\frac{1}{2} \times 24$ , Wheels, leading and trailing 48; Driving 8' 6" - Height of Engine in working order = 63,840 lbs.*

*The object in building the "Cornwall" was to prove that the narrow gauge could have a larger driving wheel - viz 8 ft. 6 in. - than the Great Western, 7 ft. gauge engines of that time. The "Cornwall" when new, it is said, attained a speed of fully 79 miles an hour, and today it can run as fast as any locomotive that exists.*

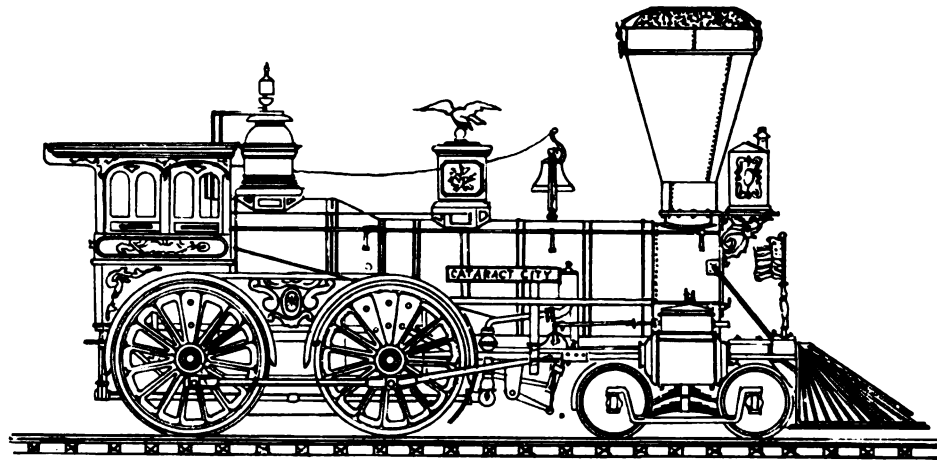


LOCOMOTIVE "CORNWALL."

*As altered by Mr Ramsbottom and Rebuilt in 1862-63*

— Locomotive Cornwall —

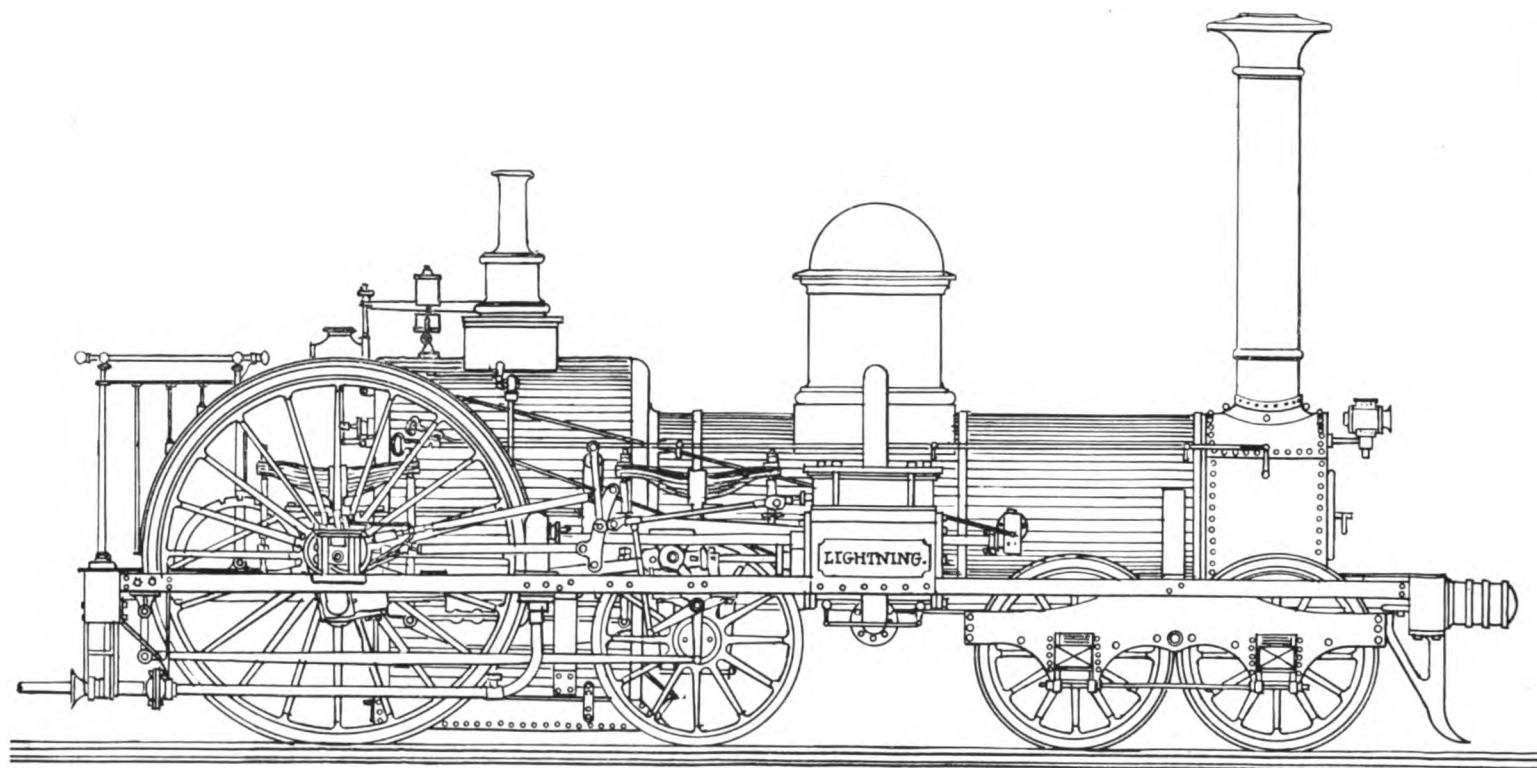
*This cut shows the locomotive "Cornwall" referred to in preceding page, as altered by Mr. Ramsbottom, Mechanical Superintendent of the London & Northwestern Ry. in 1862-63.*



American Passenger Engine, by Danforth, Cooke, and Co, 1855.

— American Passenger Engine by Danforth, Cooke & Co. 1855. —

This shows the general type of locomotives turned out at the shops of Danforth, Cooke & Co at this period. The essential features of this engine are not different from those of more modern date, the stack and short-smoke box however have given place to the straight stack and extension front; the pump to the injector, and the "underhung" links to suspension links.



The "Lightning" of 1849

~ The "Lightning" of 1849. ~

This Engine was built at Schenectady, N. Y. by the Norris Locomotive Works, which located at that place, for the Syracuse and Utica Railroad, and made her first trip in December, 1849.

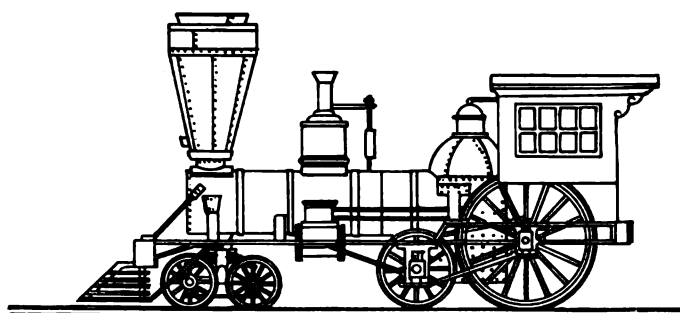
Her fastest record was 16 miles and 88 feet in 13 minutes and 21 seconds, hauling 8 - eight wheel cars.

Cylinders 16x22 - drivers 84" dia., carrying wheels 48" dia. and front truck wheels 42" dia. All these wheels were solid forgings, the first of their kind ever made in America.

Boiler 42" dia., 116 - 2" tubes, 10' 3" long, firebox 54" long 36" wide, 54" deep, water space 3'.

The Gooch Link was used and the gear arranged to cut off at any point from  $\frac{1}{8}$  to  $\frac{7}{8}$  of the stroke. Engine weighed 20 tons.

The load on the drivers could be varied by changing the fulcrum pin between the equalizer and the frame. The extra notches are shown in the equalizer and frame through the driving wheel.

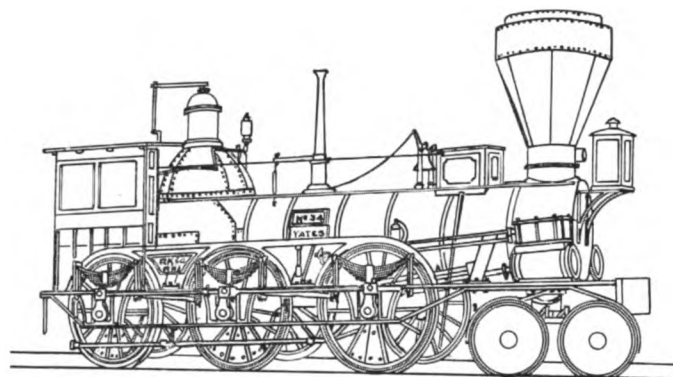


The Governor Paine—Built in 1848.

### ~ The Governor Paine, 1848 ~

This Engine, was built for the Vermont Central Railroad in 1848. It had one pair of driving wheels  $6\frac{1}{2}$  ft. in diameter, placed back of the firebox and a four wheeled truck carried the front of the engine. The cylinders were  $17\frac{1}{2}$ " dia. and 20" stroke, and were placed horizontally between the frames and the boiler at about the middle of the waist. The object of placing the cylinders at the middle of the boiler was to lessen or obviate the lateral motion of the engine produced when the cylinders were attached to the smoke box. The connecting rods took hold of "half cranks" inside of the driving wheels. The bearings on the two rear axles were so contrived that, by means of a lever, a part of the weight of the engine, usually carried on the wheels in front of the firebox could be transferred to the driving axle.

This Engine was rebuilt by Matthias W. Baldwin and was used for several years on the V. C. Railroad and then rebuilt into a 4 wheeled machine and it was stated that it could be started from a state of rest and run a mile in 43 seconds.



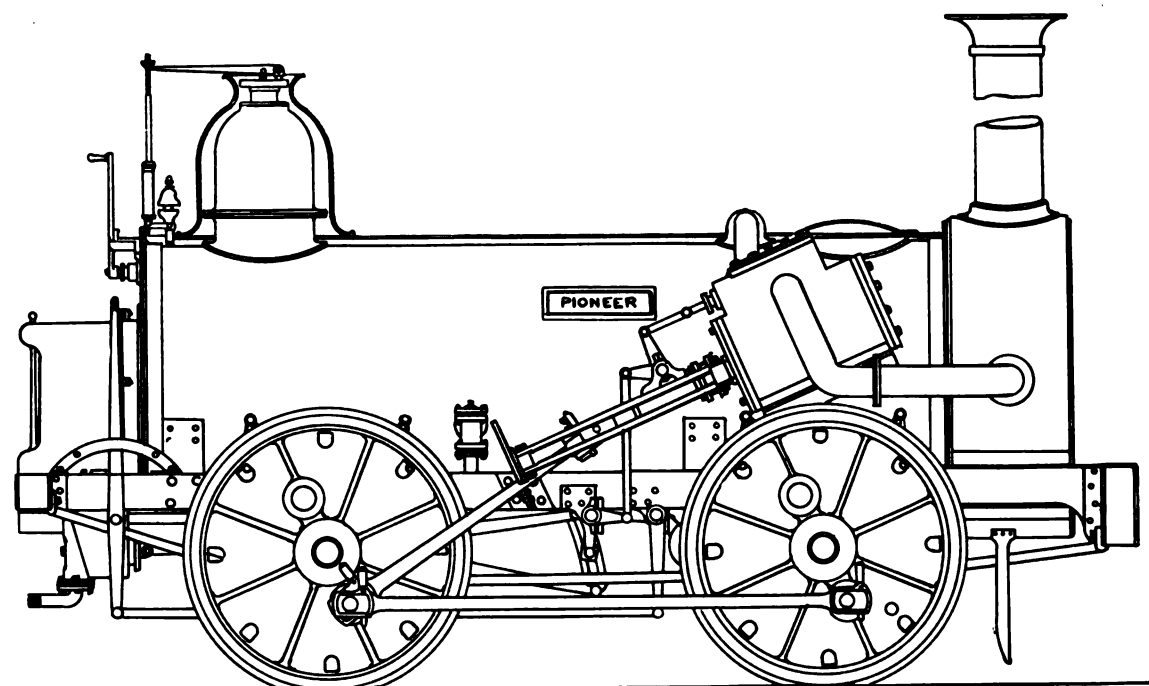
Rogers, Ketchum, & Grosvenor's Ten-wheel Engine, 1848.

~ Rogers, Ketchum and Grosvenor's, Ten-Wheeled Engine, 1848 ~

This cut shows the class of freight engines used at this period on the New York and Erie Railroad, the gauge of which was six feet.

They were built by Rogers, Ketchum and Grosvenor of Paterson, New Jersey. They had 6 coupled 5 ft. wheels and a bogie truck, cylinders 18" dia. 20" stroke, weight of engine 30 tons, grate surface 14.67 sq. ft., heating surface in firebox 72 sq. ft., 198 tubes 13 ft. long  $1\frac{3}{4}$ " dia. presenting a heating surface of 1127 sq. ft.

The form of crank axle known as the "half crank" by Baldwin, was extensively used on this class of engine.



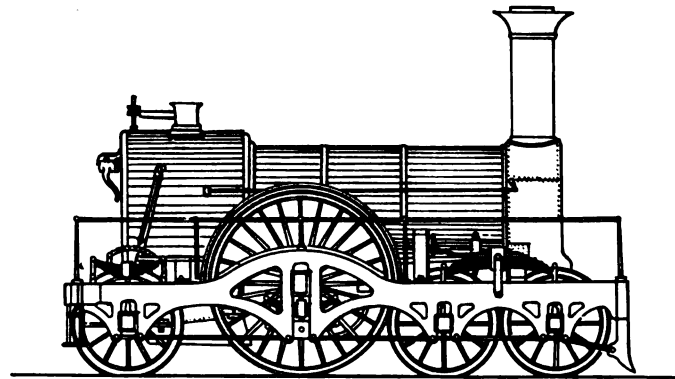
The "Pioneer", 1850.

--- The Locomotive "Pioneer", 1850 ---

This Locomotive was the first introduced on the St Andrews and Quebec Railway, which was the first railroad chartered in Canada.

The Pioneer was built by Robt. Stephenson and Co. Newcastle-on-Tyne in 1850.

For a number of years this Engine ran between St Andrews and Dumbarton on 45 lb. V rails laid on longitudinal stringers.



Great Western Express Engine, 1851.

*Great Western Express Engine, 1851 -*

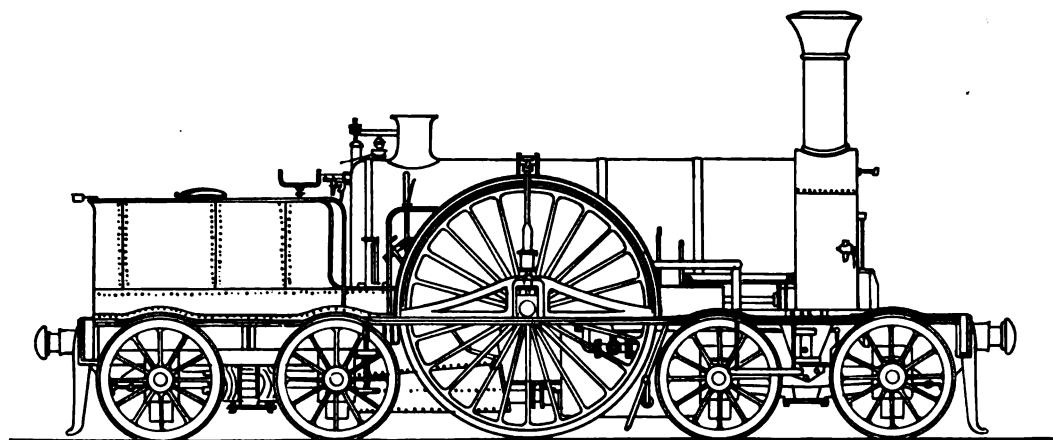
*This cut shows the standard express engines used on the Great Western Railway of England at this period.*

*The dimensions are as follows. - - - /*

*Cylinders 18" x 24" - 8 ft. driving wheels, boiler, 4' 6" diameter, 305 tubes 3" dia. 11' 3" long, gauge of track, 7 feet.*

*They present no unusual features of design, other than their great size.*





Bristol and Exeter Engine, 1853.

— Bristol and Exeter Engine, 1853. —

The large tank engines were built by Rothwell and Co. of Bolton-le-Moors for the Bristol and Exeter Railway of 7 ft gauge of track.

They had  $16\frac{1}{2}$ " cyls, 24" stroke, driving wheels 9 ft. in diameter and two trucks of 4 wheels each, these wheels being 4 ft. dia.

The boiler was  $48\frac{1}{2}$ " dia. with 180 tubes  $1\frac{5}{16}$ " dia., the barrel being 10' 9" long. The drivers had no flanges, India rubber springs were applied under all the axle bearings, weight of engine loaded, 42 tons.

These engines are reported to have run at the rate of 80 miles per hour.

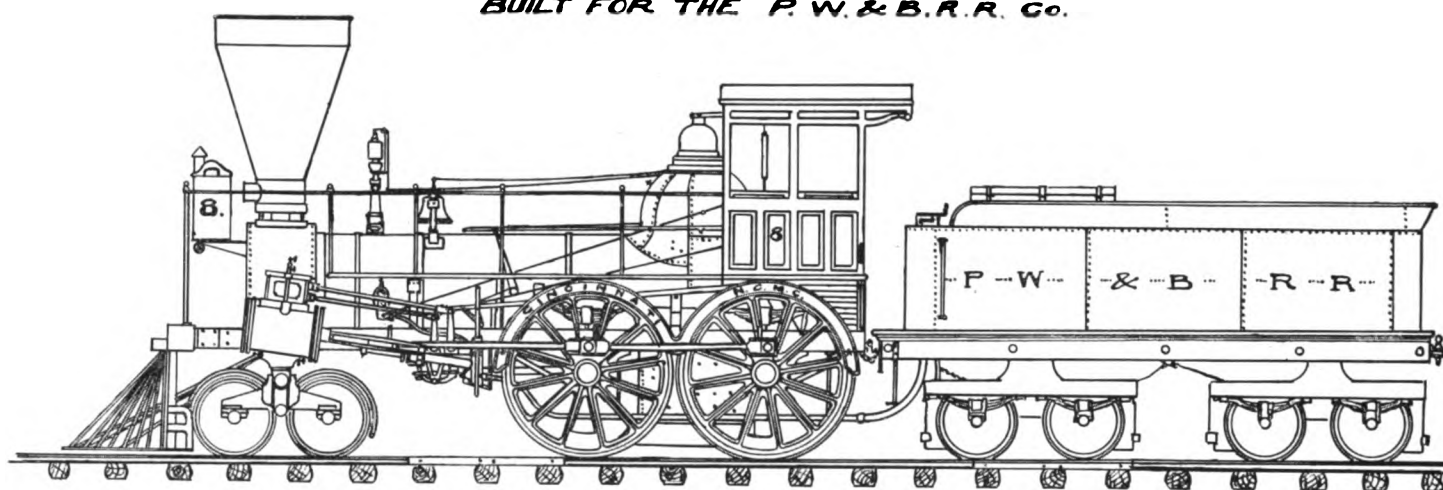
PASSENGER ENGINE & TENDER BUILT BY THE  
NEW CASTLE MANUFACTURING COMPANY, 1853.

W. H. DOBB MASTER MACHINIST.

DIAM. OF CYL. 15 & 20" STROKE.  
DRIVERS 3.6" DIAM.

BOILER CONTAINS 109 TUBES  
10.8" LONG & 2 OUT SIDE DIAM.

BUILT FOR THE P. W. & B. R. R. CO.



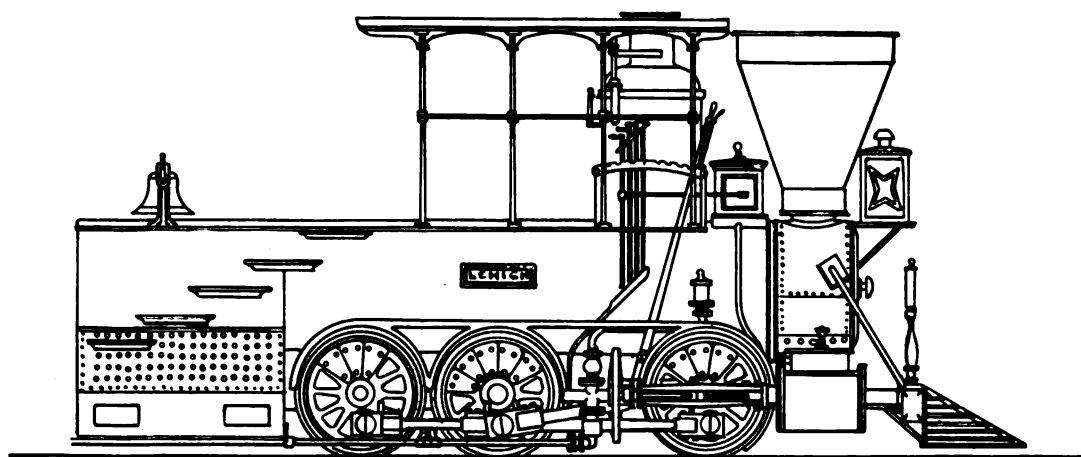
— Phila Wilm and Balto. Railroad Pass. Locomotive, 1853. —

This cut shows a passenger engine, built by the Newcastle Mfg. Co. of Newcastle, Del. for the P. W. & B. R. R.

This Company was incorporated Jan'y. 25<sup>th</sup> 1833 for the manufacture of cotton, woolen and metal goods by Thos. Janvier, Jas. Cooper, Jas. Rogers, Jas. Smith and Chas. I. Dupont.

In 1834 a foundry was built and shops erected, to make Locomotives. The shops were a long time in charge of W<sup>m</sup> H. Dobbs and locomotives for use on the Newcastle and Frenchtown Railroad were built there.

Subsequently the Hicks Engine Co. occupied these shops which were afterward used by the Morris Tasker Iron Works.



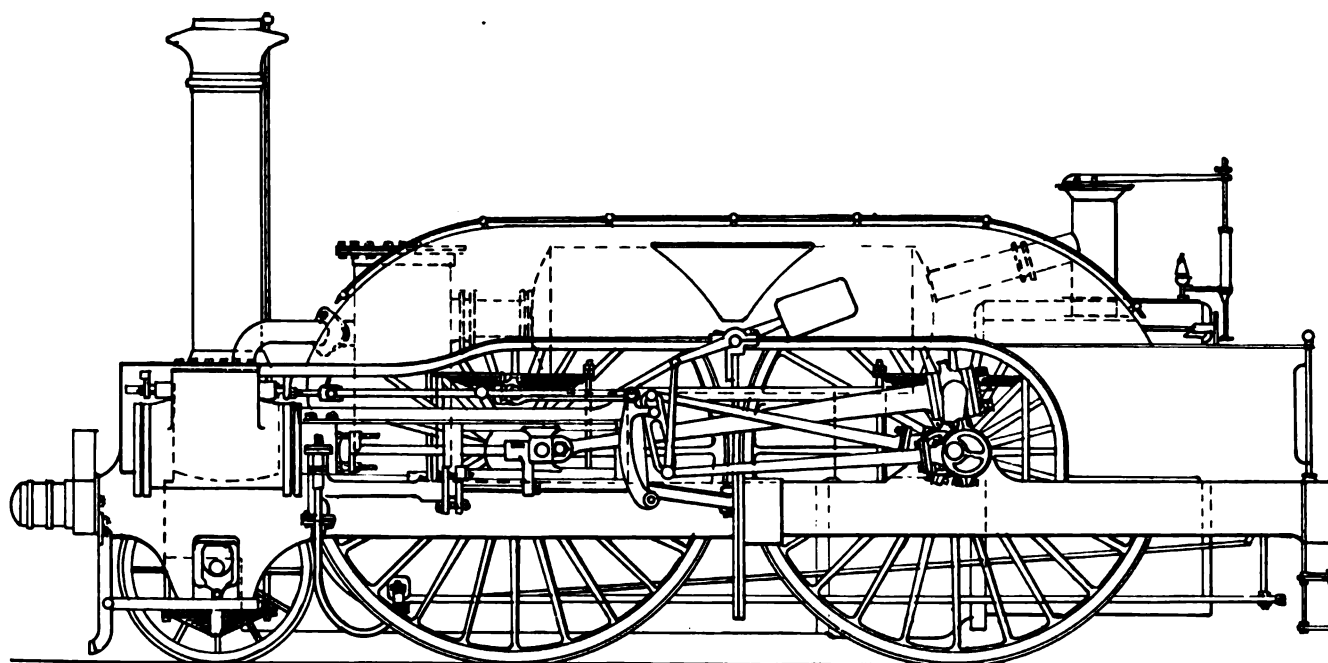
Colburn's Engine for Burning Anthracite Coal, 1854.

— Colbourn's Engine for Burning Anthracite Coal, 1854 —

This Engine was designed and constructed by Zerah Colbourn, Engineer, to the New Jersey Locomotive Works at Paterson in 1854.

Cyls. 18x24, six coupled wheels 4 ft. dia. The boiler 50" dia. had 91 iron tubes 3" dia. 15.6" long, a length which permitted the firebox to be placed entirely behind the driving wheels and thus a clear width of 7.6" was obtained for the fire grate, the bars being 6 ft. long.

The spreading of the firebox to a width greater than that of the gauge of the line by placing the firebox behind the wheels had been carried out in 1852, by Mr. Colbourn, in a number of tank engines for a contractor's line of 3.3 gauge, that of the permanent (the Great Western Railway of Canada) being 5.6" - - -



MM. Blavier and Larpent's Engine "L'Aigle." 1855.

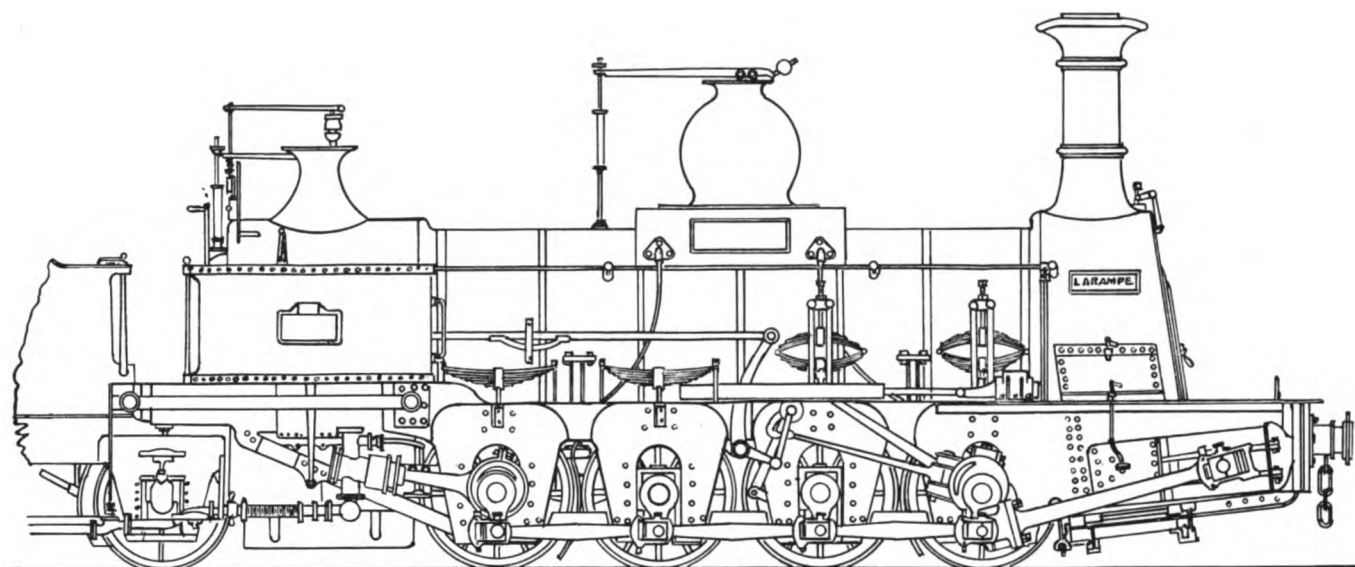
— *MM. Blavier and Larpent's Engine "L'Aigle" 1855.* —

This Engine, was designed by MM. Blavier and Larpent, and made by Messrs Gouin of Paris, for the Western Railroad of France and was exhibited in the Paris Exposition of 1855.

The engine had  $16\frac{1}{2}$ " cylinders,  $31\frac{1}{2}$ " stroke and four coupled wheels of 9' 4" diameter.

The form of the boiler was such as to permit of the convenient disposal of the axles, but as the Engine never answered any useful purpose, probability is given to the natural suspicion, that such a boiler could not produce steam rapidly and economically.

She was the most striking example of the employment of large driving wheels on a narrow gauge road.

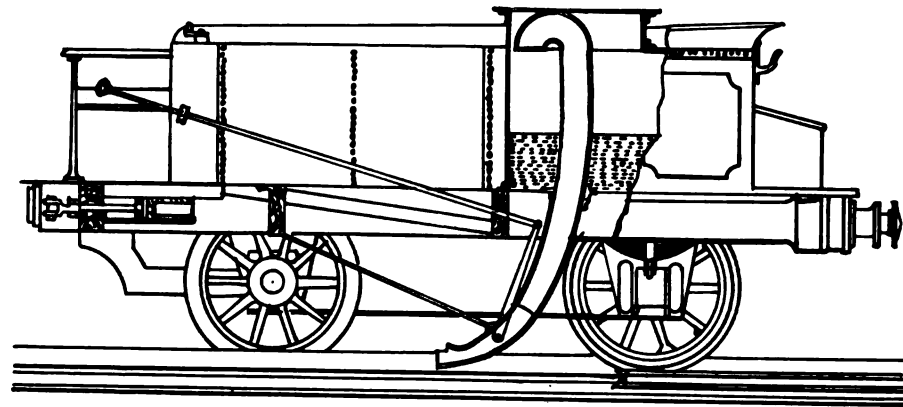


Bugniot's Goods Engine, by Koechlin, 1860.

— Bugniot's Goods Engine, by Koechlin, 1860 —

Messrs. Koechlin of Mulhouse, made two engines upon M. Bugniot's plans in 1860, which were for some time worked upon the Paris, Lyons and Mediterranean Railway.

The principal dimensions were as follows, —  
 Cylinders,  $21\frac{1}{4} \times 22$  stroke, diameter of drivers  $3.11\frac{1}{4}$ , total heating surface  $1861\frac{1}{2}$  square feet, height of Engine 46 tons  $11\frac{1}{4}$  cwt., total weight of engine and tender  $69\frac{3}{4}$  tons.



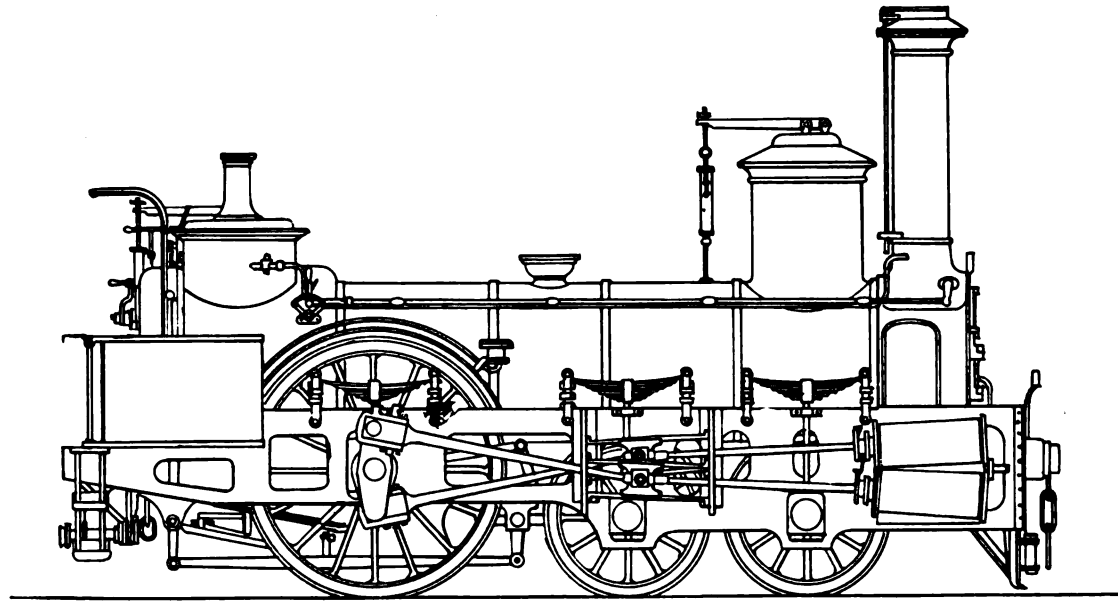
Ramsbottom's Self-Filling Tender, 1860.

~ Ramsbottom's Self-Filling Tender, 1860. ~

This method of filling Tenders of Locomotives with water, while the train is in rapid motion, was perfected and adopted by Mr. Ramsbottom Mechl. Supt. of the London and North Western Railway in 1860.

At Conway on this line, he had a pair of cast iron troughs put down, 441 yards long, with a further length at each end of 16 yards rising 1 in 100. They were 18" wide and 7" deep, and were placed, one between the rails of each line and so that the water 5" deep stood at about the level of the rails.

The scoop was 10" wide at the mouth and dipped 2" under the surface of the water.

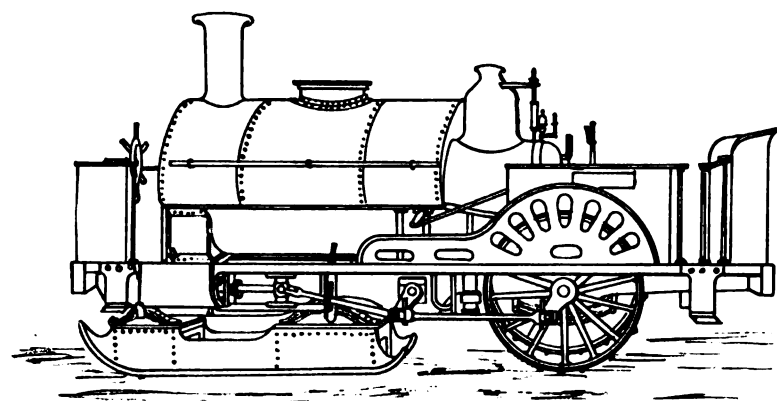


Haswell's Four Cylinder Locomotive, 1861.

— Haswell's Four Cylinder Locomotive, 1861. —

This Engine was made by Mr. John Haswell of the Austrian State Railway Works at Vienna, and exhibited in the International Exhibition of 1862.

This engine was designed to run with the utmost steadiness at high speeds and for this purpose two cylinders with their working parts were provided for each driving wheel, and by connecting the pistons to crank pins diametrically opposite to each other the whole momentum of each set of reciprocating parts was balanced by that of the other set.



Grew's Ice Locomotive, 1861.

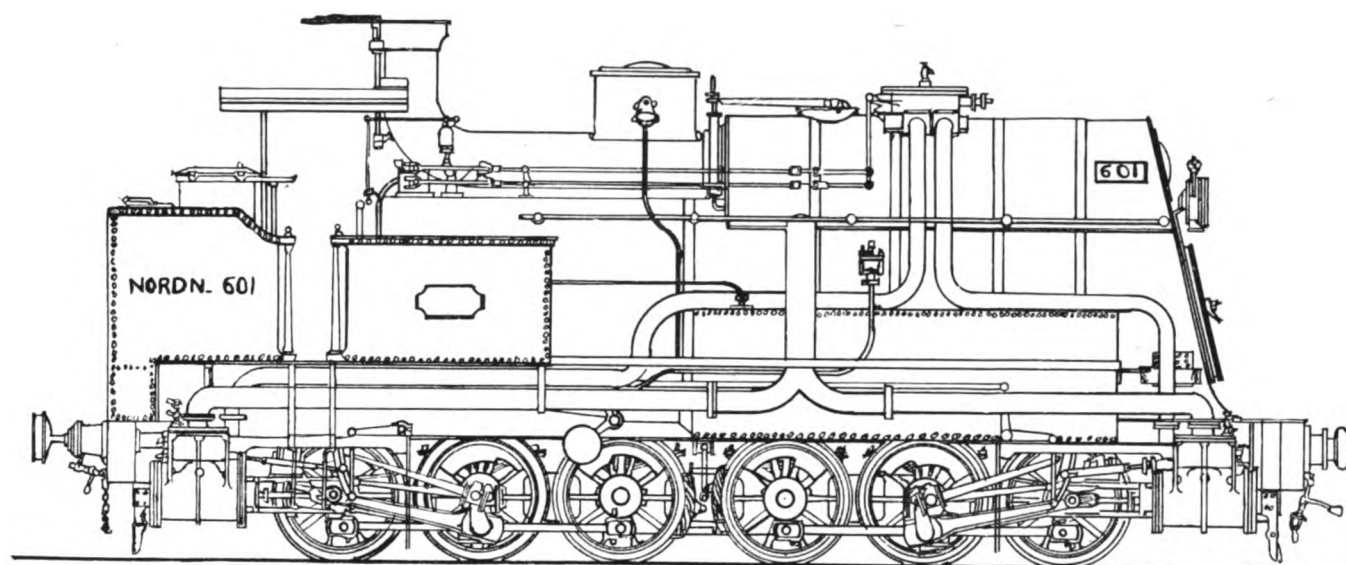
— *Grew's Ice Locomotive, 1861.* —

This cut represents an Engine designed by Mr. Nathaniel Grew and made by Messrs. Neilson & Co. and sent to Russia for the purpose of working on ice.

Its weight was about 12 tons, cylinders 10" dia. by 22" stroke, and dia. of drivers 5 feet. The tires were studded with short steel spikes to obtain sufficient adhesion. The engine was steered by hand gear acting upon the front end of the sledge.

This Engine was regularly worked on the Russian rivers in the winter of 1861-62 in the transportation of passengers and freight.





Petit's Engine by Gouin Paris, 1863.

### ~ Petit's Engine by Gouin, Paris, 1863 ~

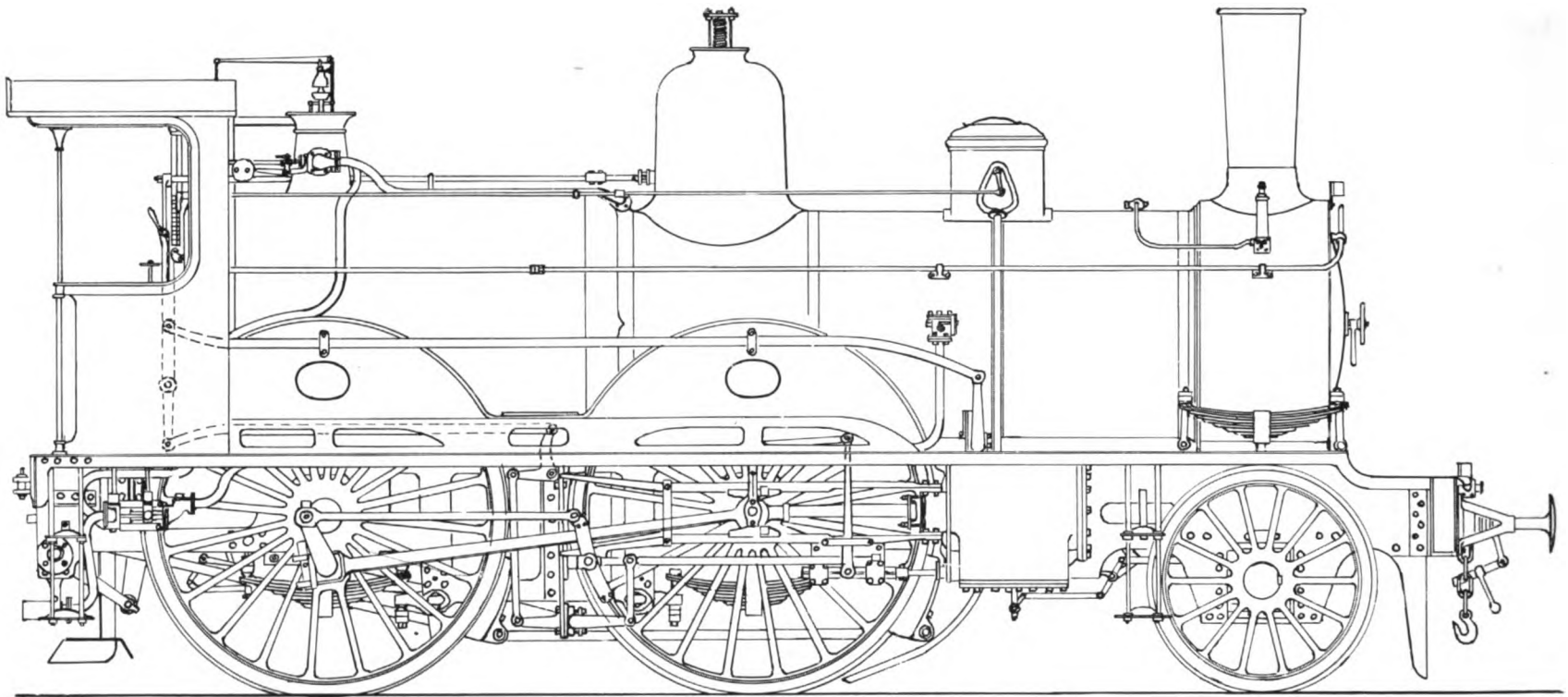
This Engine was designed by M. Petit, engineer-in-chief of the Northern Railway of France, and constructed by M. Gouin & Co. of Paris.

It had 6 pairs of drivers, grouped in sets of 3 each, each set being worked by a separate pair of cylinders.

Cylinders  $17\frac{1}{3}$ " dia.  $\times$   $47\frac{1}{3}$ " stroke; dia. of drivers 3' 6", total wheel base  $19' 8\frac{1}{4}$ ", weight of engine in working order 59 tons, gauge of track  $4' 8\frac{1}{2}$ ".

Boiler 58" dia., 464 tubes  $1\frac{37}{64}$ " dia.,  $11' 5\frac{3}{4}$ " long, firebox  $72\frac{3}{4}$ " long  $70\frac{7}{8}$ " wide placed above the drivers; boiler pressure 118 lbs.

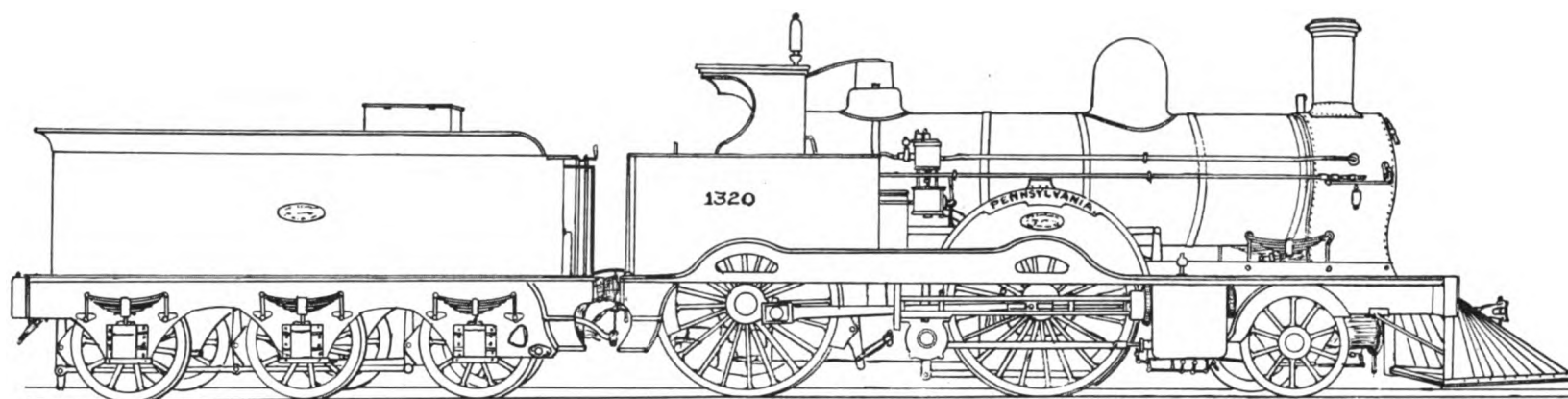
The waste heat, instead of passing directly to the stack, traversed a tubular steam chamber for drying the steam, the stack and blast pipe were placed horizontal and stack was turned up at its end.



*Compound Locomotive, Northern Railway of France 1886.*

*These engines were built for high speed passenger service by the Alsation Society in 1886, and have four cylinders, two of which are high pressure and two low pressure. The two high pressure being placed inside, and the two low pressure on the outside; the high pressure being attached to the front pair of drivers, and the low to the back pair, the wheels themselves not being connected with parallel rods.*

*Cylinders 13" and 18" by 24" stroke; heating surface 1109 sq. ft. drivers 82.68 inches diameter; weight of engine 74500 lbs.*



THE COMPOUND LOCOMOTIVE "PENNSYLVANIA."

### English Compound.

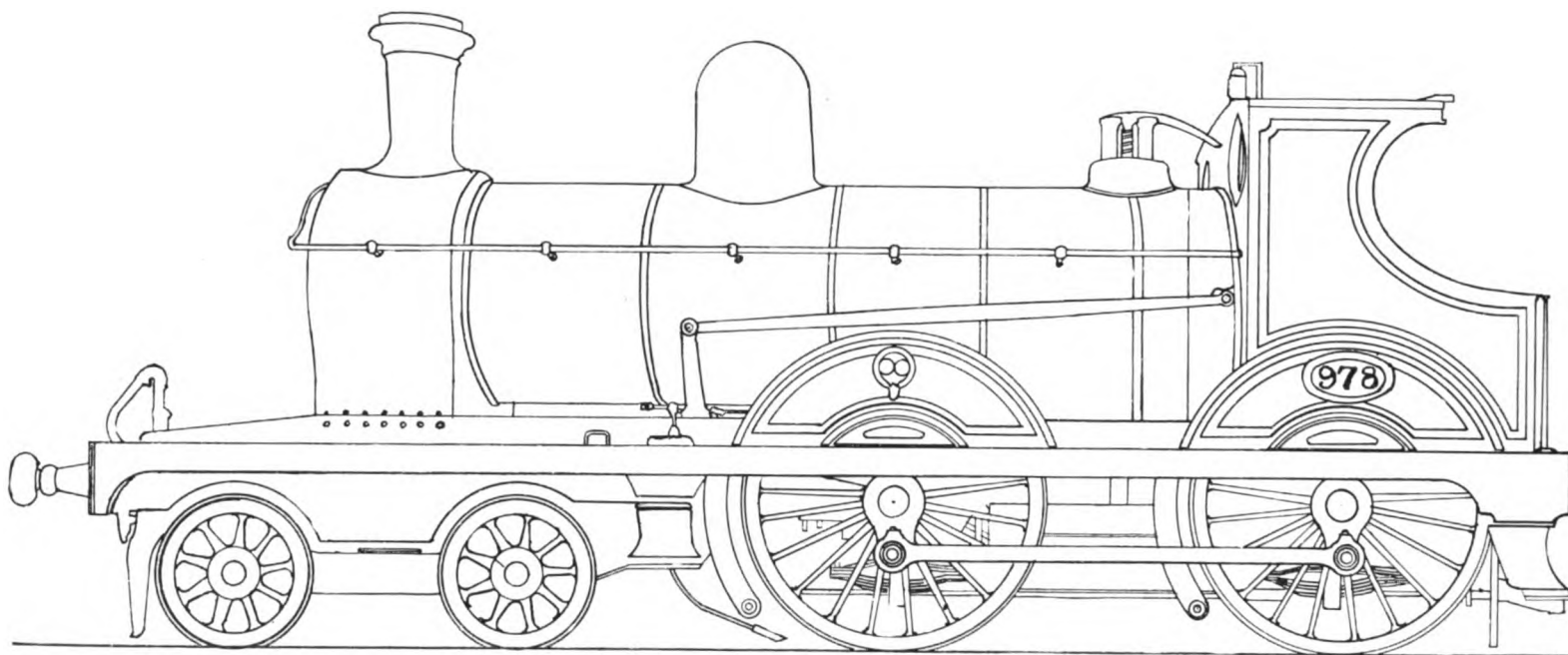
This engine was built by the firm of Messrs Bayer, Peacock & Co. of Manchester, England, and was imported to this country by the Pennsylvania R.R. Co. for experimental purposes in 1889.

The compounding features were designed and patented by Mr. F. W. Webb, Mech. Supt. London & North Western Ry.

The engine had three cylinders, two outside high pressure and one low pressure, - the latter being located on center line of engine between the frames and under the smoke box. The driving wheels were not coupled together but the forward pair was driven by the low pressure cylinder, and the rear pair by the high pressure cylinders.

The dimensions were as follows: cylinders 14" x 30" by 24" stroke. driving wheels 75" dia.; heating surface sq. ft., total weight in working order 95200 lbs.

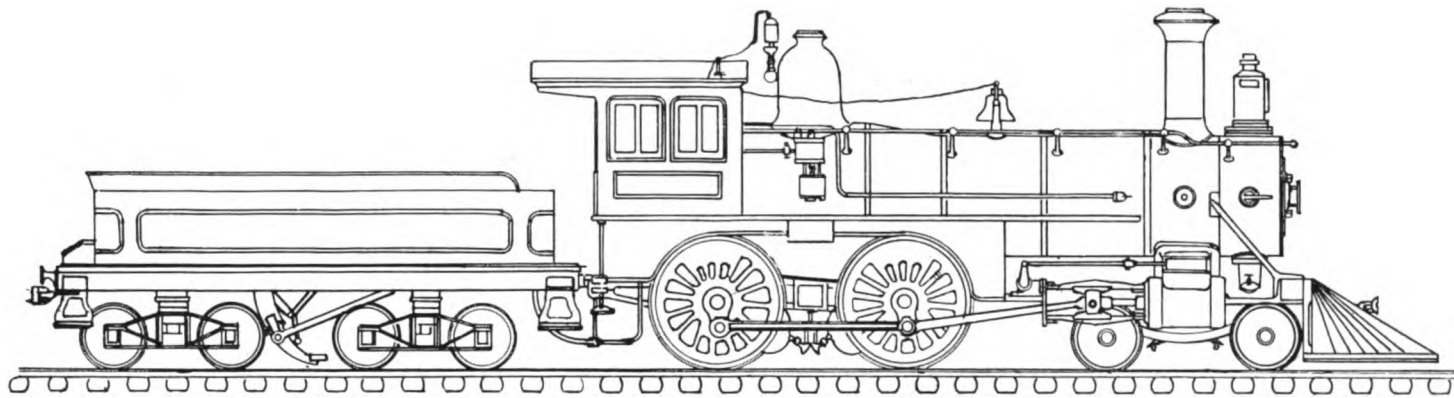
This engine ran on the Penn. R.R. for some years, but not proving a success was finally relegated to the scrap pile.



A MODERN ENGLISH EIGHT-WHEELER.

— A Modern English Eight Wheeler 1892. —

This cut gives a general outline of the style of passenger locomotive used in England during this period and few changes have been made in the design up to the present day.



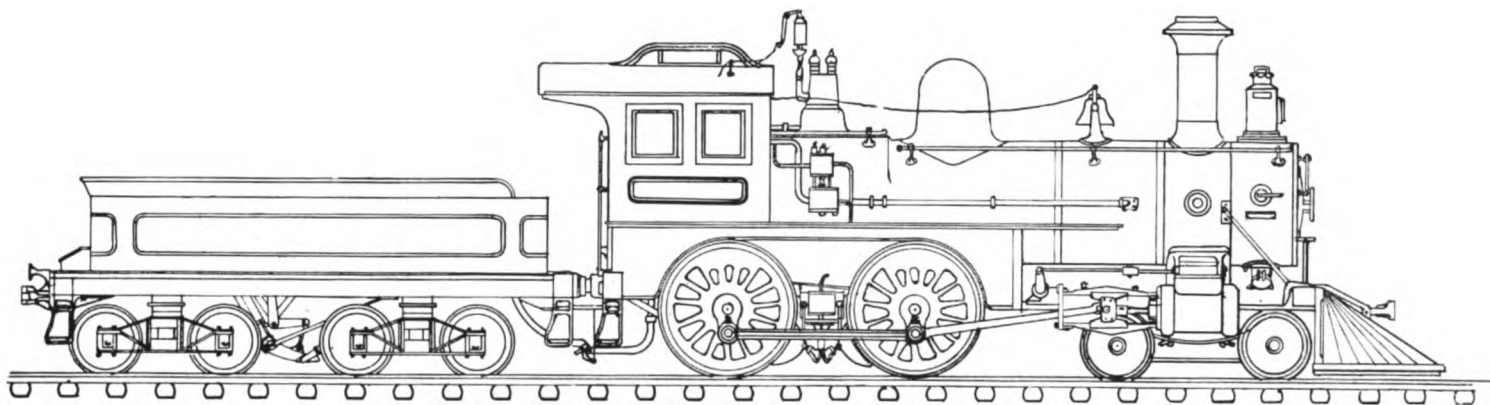
Pennsylvania R.R. Co's Passenger Locomotive, 1887.

*Pennsylvania R.R. Co's Passenger Locomotive, 1887.*

*This cut shows the standard passenger locomotives of the Pennsylvania R.R. Co in 1887, and which were built at the shops of the Company at Altoona, Penn. from plans and specifications prepared by the Mechanical Engineers Office.*

*The cylinders are  $18\frac{1}{2}$ " dia. by 24" stroke; drivers 68" dia. heating surface 1530 square ft.; total weight of engine in working order 100,600 lbs.*

*These engines had wagon top boilers, which type has since been superseded by the Belpaire boiler. Tenders were of 3600 gallons water capacity and fitted with water scoop.*



**Modern American Passenger Locomotive, Pennsylvania Railroad, 1892.**

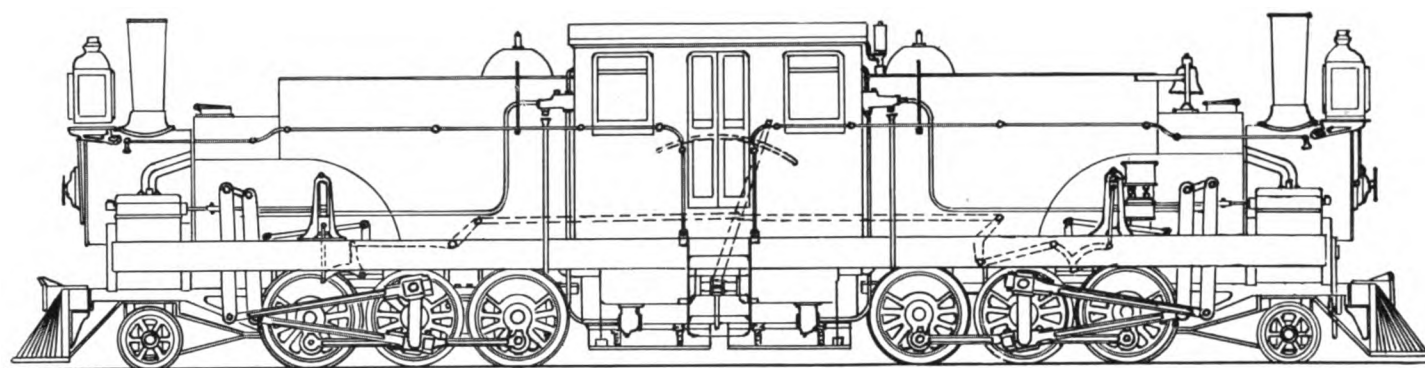
— Modern American Passenger Locomotive Pennsylvania R.R. 1892.

This cut shows the standard passenger locomotives of the Pennsylvania R. R. Co in 1892, and were built at the Company's shops, from designs prepared by the Mechanical Engineer.

The cylinders are  $18\frac{1}{2}$ " diameter by 24" stroke; drivers 68" diameter; heating surface 1572 square feet; total weight of engine in working order 113,700 lbs.

These engines are equipped with Belpaire boilers, which is still the standard type of this company.

Tenders have a water capacity of 3600 gallons and are fitted with scoop to take water while running.



— *Johnstone Double Bogie Compound Locomotive 1892* —

This engine was designed by Mr. F. W. Johnstone, Supt. of Motive Power and Machinery of the Mexican Central Ry. in 1892.

The two boilers of the engine are carried on a long rigid frame and the fire doors are on the sides; the water supply is carried in saddle tanks and the front trucks are of the two wheeled radial type pivoted to the main frame.

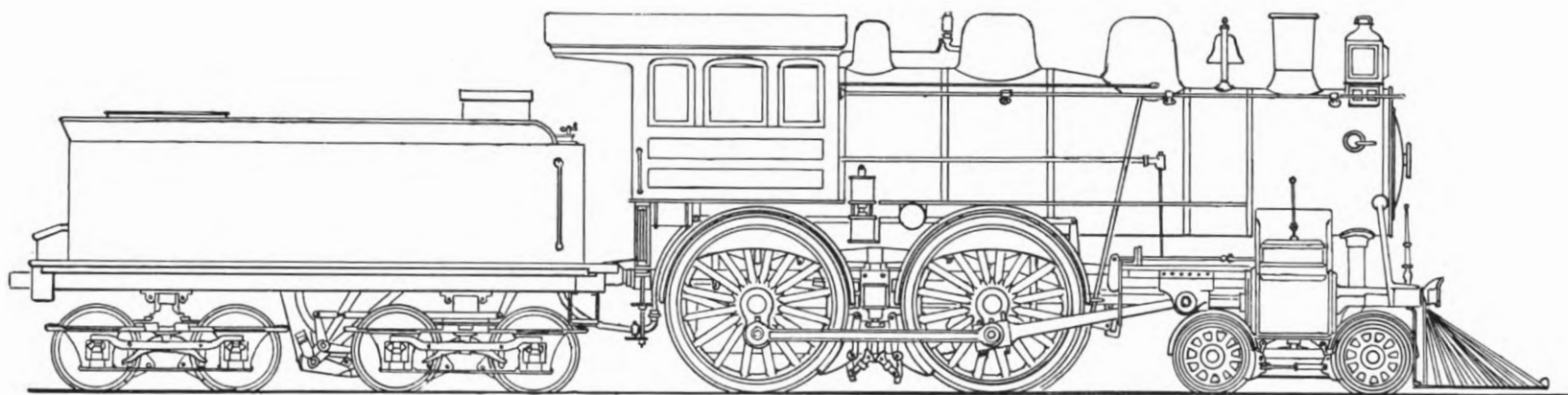
The dimensions are as follows; cylinders 13" and 28" by 24" stroke; driving wheels 40" dia; total wheel base 45 feet 11 inches, weight on driving wheels 200,000 lbs; total weight of engine 230,000 lbs.

The engine was designed for work on long grades of 100 feet per mile, with 18 to 22 degree curves and was of novel design and great power.

On account of the great amount of curvature, heavy consolidation or decapod engines, could not be used to advantage and it was necessary to obtain a heavy powerful engine with a very flexible wheel base and the design shown herewith was the result.

The cylinders are annular, the high pressure being inside the low and each combined cylinder is equal to a single expansion cylinder of 19" dia.

This engine was designed to haul freight trains between Tampico and Mexico.

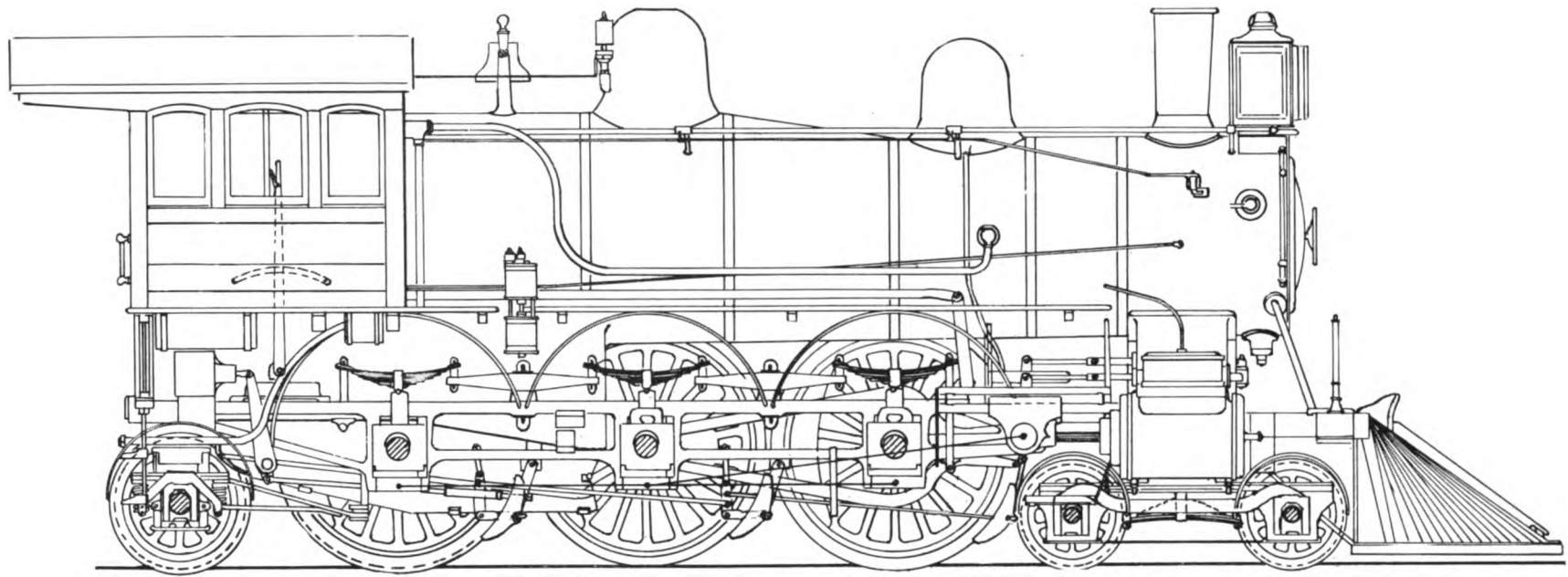


— American Express Locomotive 1893. —

This type of engine is in service on the New York, New Haven and Hartford R.R. and was built by the Rhode Island Locomotive Works, and was designed for fast runs with very heavy trains.

Cylinders 20"x26"; driving wheels 78" diameter; heating surface 1290 square feet; Weight in working order 125,000 lbs.



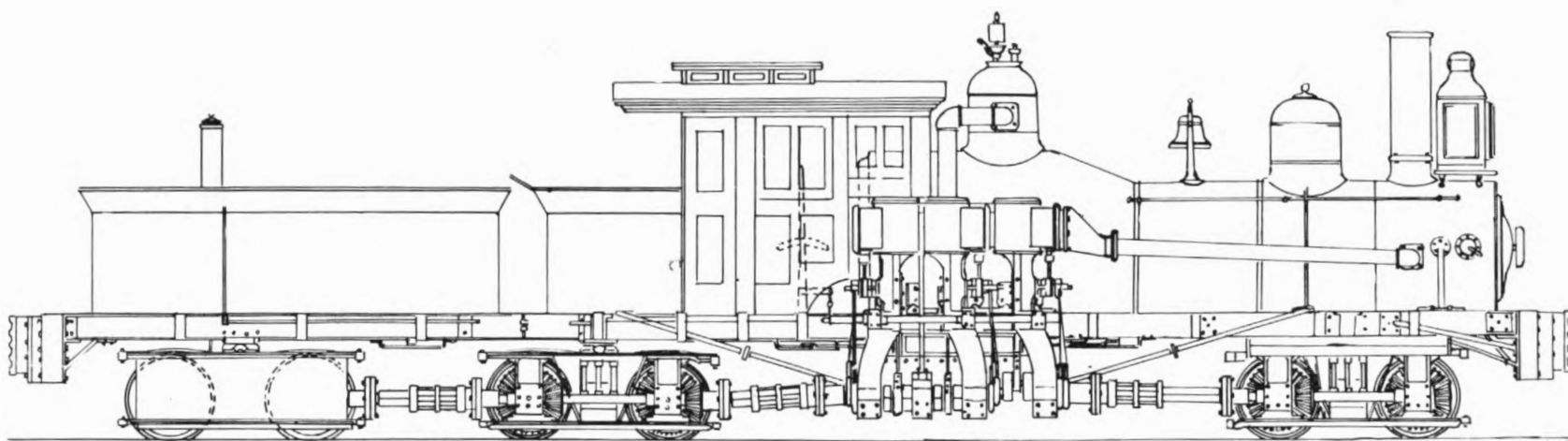


— Compound Express Locomotive 1893. —

This engine was built for the Chicago Milwaukee & St. Paul R.R. by the Rhode Island Locomotive Works, and is of the ten wheel type, although there are twelve wheels under the engine.

It is a two cylinder compound, cylinders 21" and 31" by 26" stroke, driving wheels 74" dia.; heating surface 1788 square feet. weight of engine in working order 150,000 lbs.

This engine was exhibited, at the Worlds Fair, Chicago and attracted universal attention.

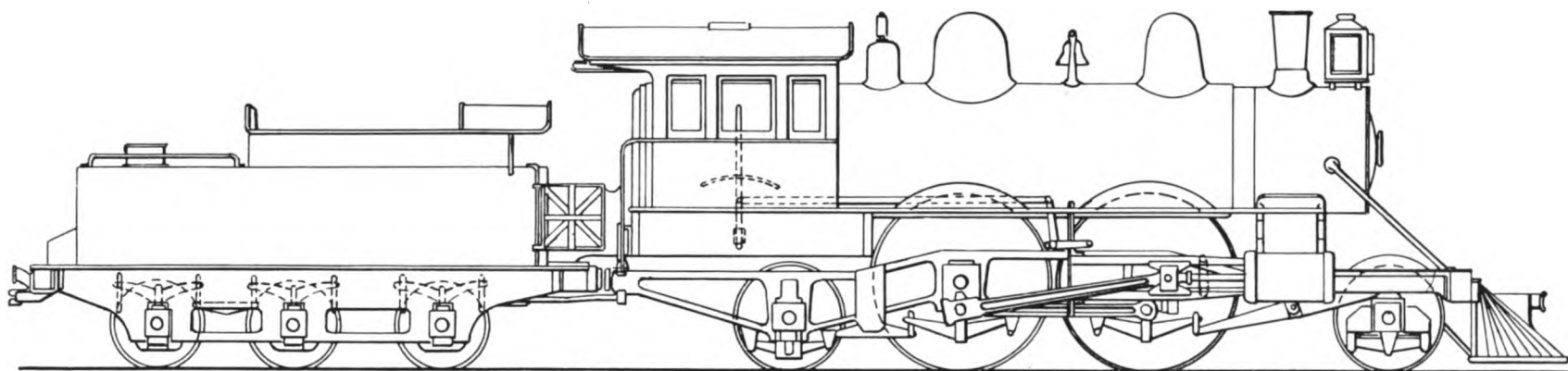


— *A Shay Locomotive 1895.* —

These engines are built by the Lima Locomotive and Machine Works and the object in building them in the manner shown is to have the shortest possible rigid wheel base and the longest possible wheel base, thus utilizing all the weight for traction and it is possible to work the engine on very short curves, the one illustrated running easily on  $65^{\circ}$  curves.

Its use is confined to roads having heavy grades and sharp curves and restricted to slow speeds.

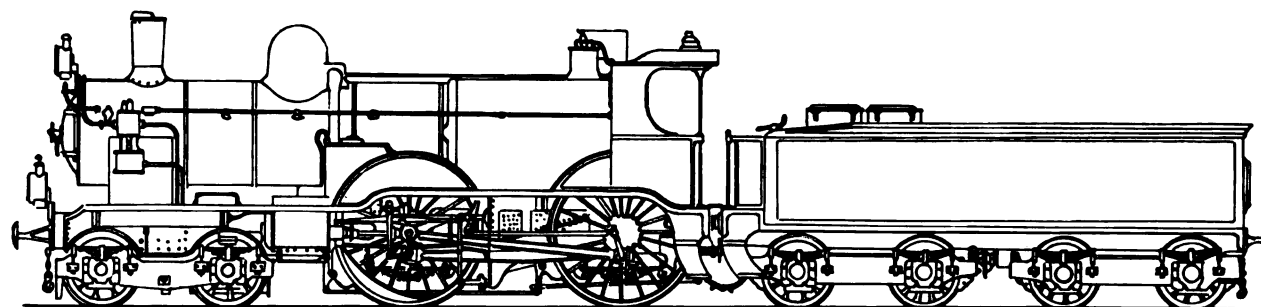
The engine has three cylinders  $14\frac{1}{2}$ " dia. and 12" stroke; total weight of engine in working order 156,000 lbs; number of drivers 12. About 500 of these locomotives are in service in the United States, Canada and South America.



— Fast Passenger Locomotive 1895. —

This engine was placed in service on the Chicago, Burlington and Quincy R.R. in 1895, and is known as the "Columbia" type and built by the Baldwin Locomotive Works.

Cylinders 19" x 26", drivers 84½" diameter - heating surface 1580 square feet, total weight in working order 138,000 lbs.

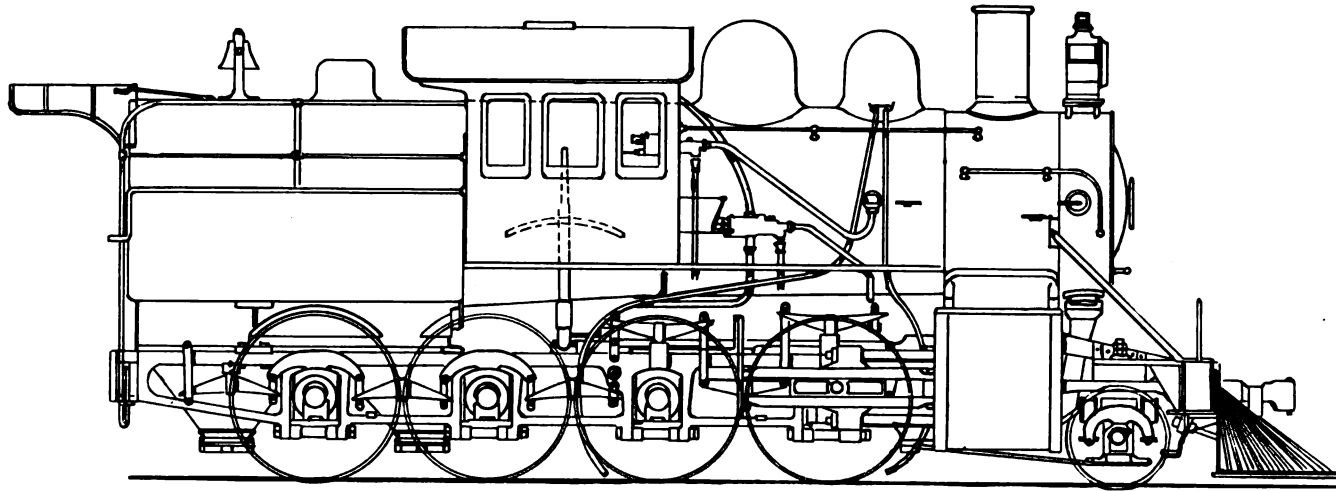


— Four Cylinder Compound Express Engine 1898 —  
 — Chemin de Fer du Nord - France. —

These engines were built for the above company by the  
 Alsatian Engine Co. of Belfort France

The outside high pressure cylinders are  $13\frac{1}{2}'' \times 25.2''$  stroke  
 and the inside low pressure  $21'' \times 25.2''$  stroke; weight in  
 working order  $51\frac{1}{2}$  tons; steam pressure 220 lbs. per square inch.  
 This type of engine is now used on most of the leading  
 French Railways and the type illustrated has attained  
 the continental record for speed with the Calais-Rome  
 express, weighing about 160 tons by running nearly 82  
 miles in 85 minutes.

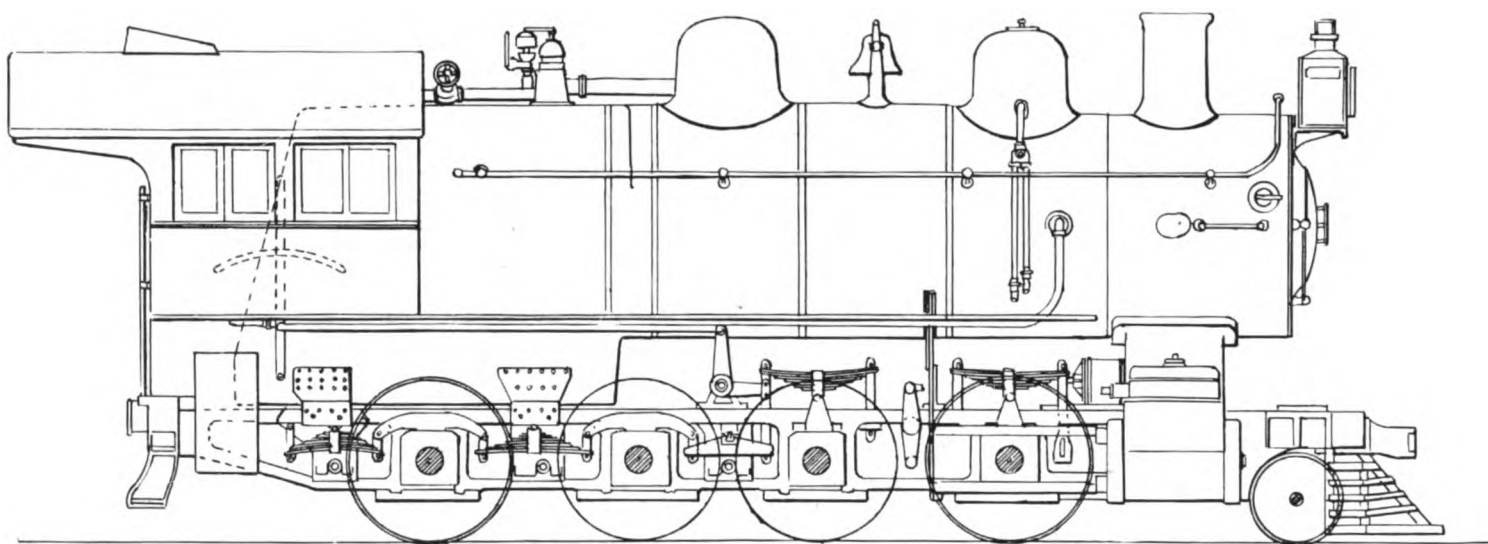
Note, the high pressure pistons drive one axle, and the low  
 pressure pistons drive the other, all wheels however being  
 coupled together; the Walschart valve gear is used.



— American Compound Consolidated Road Locomotive 1899. —

This engine was built by the Baldwin Locomotive Works for the Lehigh Valley R.R. and is capable of pulling 2000 tons exclusive of engine and tender.

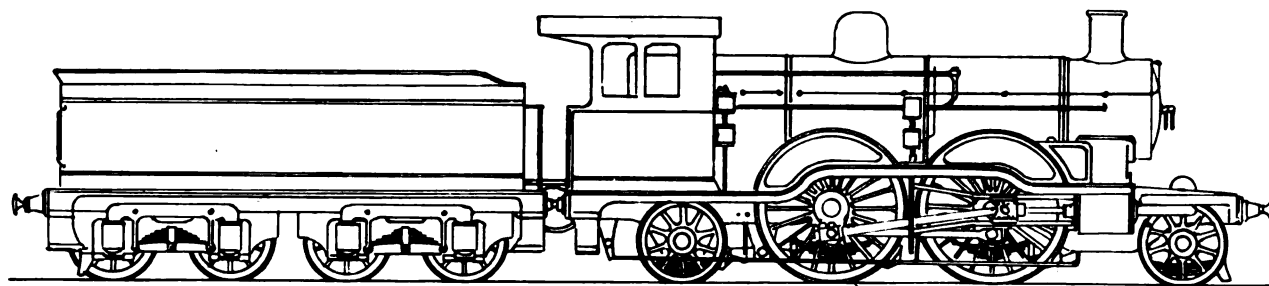
Cylinders are 17" and 28" by 30" stroke; driving wheels 62" diameter; total heating surface 2987 square feet; draw bar pull 47000 lbs, and total weight of engine 175,000 lbs. These engines are used on the Buffalo division of the above road, where the grades average 20 feet per mile and are 35 miles long and do the work previously done by two engines.



— Simple Consolidation Freight Locomotive 1899. —

These engines were built by the Pennsylvania R.R. Co. for heavy freight service; cylinders  $23\frac{1}{2}'' \times 28''$ ; drivers 56" diameter; heating surface 2917 square feet; weight in working order 186,500 lbs; boiler Belpaire type; tractive power of engine 35,816 lbs.

These engines were designed with especial care and intelligence and may be classed among the highest types of freight locomotives of today.



~ English Four Coupled Express Locomotive 1899 ~

This cut shows a design for a locomotive of the "Atlantic" type, now being introduced in England.

These engines have driving wheels 84" diameter a total heating surface of 1950 square feet; a steam pressure of 200 lbs per square inch; cylinders  $18\frac{1}{2}$ " dia by 26" stroke and weigh in working order 136,600 lbs.











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Wright  
Pictorial history of the  
locomotive

